OPERATING AND SERVICE MANUAL

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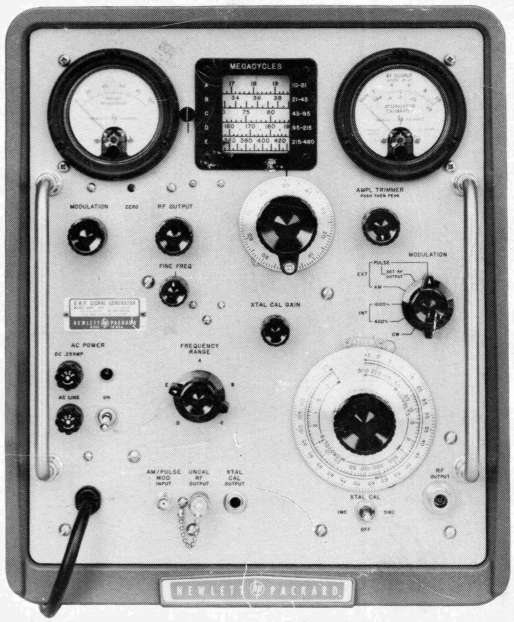
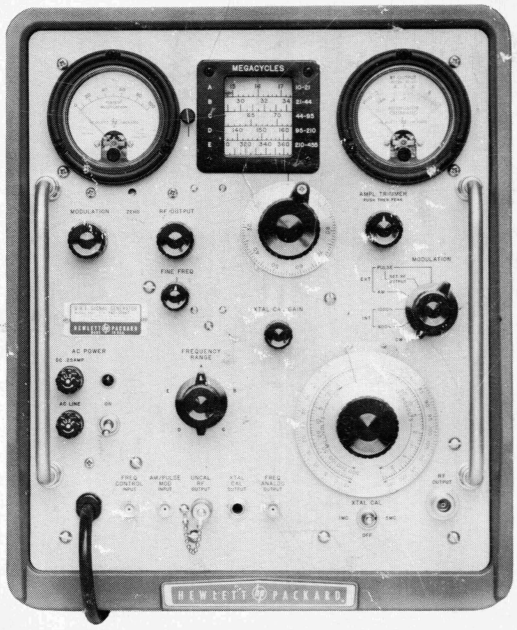
VHF SIGNAL GENERATOR

608E/F





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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

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MANUAL CHANGES

VHF SIGNAL GENERATOR
608E/F
Manual Printed: FEB 1970

MAKE ALL CORRECTIONS IN THIS MANUAL ACCORDING TO ERRATA BELOW, THEN CHECK THE FOLLOWING TABLE FOR YOUR INSTRUMENT SERIAL PREFIX (3 DIGITS) OR SERIAL NUMBER (8 DIGITS) AND MAKE ANY LISTED CHANGE(S) IN THE MANUAL.

►NEW ITEM.

608E		608F	
SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
983- and above	1, 2, 3, 4	977-	1, 2, 3
		► 977-01801 and above	1, 2, 3, 4

ERRATA: Page 1-1, paragraph 1-4, first sentence:
Change to read: "The frequency of the output signal is indicated on a direct-reading dial, the calibration of which is accurate to better than ±0.5% for the 608E and ±1% for the 608F, when the cursor and FINE FREQ adjustments are properly aligned."

Page 3-1, paragraph 3-13, first sentence:
Change to read: "The frequency (MEGACYCLES) dial in the signal generators are calibrated to be accurate within ±0.5% for the 608E and ±1% for the 608F."

Page 4-4, paragraph 4-30, third sentence:
Change to read: "Cathode resistors R255 and R253 operate with resistors R254 and R256 in the plate circuit to limit plate current to a safe value."

Page 5-10, paragraph 5-24:
Change steps f and j to read:
"f. Adjust AMPL TRIMMER for peak indication on RF OUTPUT meter."
"j. Adjust pulse generator for 10-volt peak-to-peak output, 10 μsec wide."

CHANGE 1: Parts List:
Change F1 (230V) from HP Part No. 2110-0006 to HP Part No. 2110-0303.

Add J9, Connector: AC Receptacle, HP Part No. 1251-2357.

Change P1 from HP Part No. 8120-0015 to HP Part No. 8120-1348. The power cable is now detachable from the rear of the instrument.

Change S2 from HP Part No. 3101-0033 to HP Part No. 3101-1234.

Add Bracket: Power Inlet, HP Part No. 00608-00008.

Change Pilot light jewel from red, HP Part No. 1450-0020 to white, HP Part No. 1450-0413.

Change Cabinet Assy from HP Part No. 608D-44S to HP Part No. 00608-00014 (608E and 608F only).

Change Cabinet Rack Assy from HP Part No. 608D-44R to HP Part No. 00608-00015 (608ER and 608FR only).

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CHANGE 2: Figure 7-4 and Parts List:
Add C232, C: fxd, mylar, 1.0 uF, 10%, 200 VDCW, HP Part No. 0170-0072. Show it to be connected from the input to FL6 to ground *in the CW position only*.

Change S7 from HP Part No. 3100-0899 to HP Part No. 3100-2681.

CHANGE 3: Figure 7-5 and Parts List:
Change Q11 from HP Part No. 1854-0039 to HP Part No. 1854-0090.

► CHANGE 4: Figure 7-4 and Parts List:
Change C223 from C:fxd, elect, 1 μF, -10 +100%, 25 VDCW, HP Part No. 0180-0119 to C:fxd, elect, 1 μF, -10 +100%, 35 VDCW, HP Part No. 0180-0291.

Change R239 from R:fxd, met flm, 56.2K ohm, 1%, 1/2W, HP Part No. 0757-0854 to R:fxd, met ox, 56K ohm, 1%, 1W, HP Part No. 0761-0032.

VHF SIGNAL GENERATOR
608E/F

SERIALS PREFIXED:

This Operating and Service Manual applies to HP 608E/F instruments with serial number prefixes 833- above 02720 (608E) and 832- above 01500 (608F).

SERIAL PREFIXES NOT LISTED

For instruments with lower serial number prefixes a "Backdating" Appendix is supplied in the back of this manual.

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00608-90024 Printed: FEB 1970

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TABLE OF CONTENTS

Section		Page
I	GENERAL INFORMATION	1-1
1-1.	Description	1-1
1-3.	Frequency	1-1
1-5.	Modulation	1-1
1-7.	RFI	1-1
1-9.	Auxiliary Equipment	1-1
1-10.	Model 11509A Fuseholder	1-1
1-12.	Model 11508A Terminated Output Cable	1-1
1-14.	Instrument Identification	1-1
II	INSTALLATION	2-1
2-1.	Incoming Inspection	2-1
2-3.	Preparation For Use	2-1
2-4.	Power Requirements	2-1
2-6.	Power Cable	2-1
2-8.	Repacking For Shipment	2-1
III	OPERATION	3-1
3-1.	Introduction	3-1
3-3.	Controls, Indicators and Connectors	3-1
3-5.	Pre-Operational Procedures	3-1
3-7.	RF Output Loading	3-1
3-9.	Turn-On Procedures	3-1
3-11.	Calibration Procedures	3-1
3-16.	Mode Operating Procedures	3-4
3-18.	Internal Modulation	3-4
3-20.	External Modulation	3-5
3-22.	Phase-Lock Operation Procedures (Model 608F Only)	3-5
IV	PRINCIPLES OF OPERATION	4-1
4-1.	Introduction	4-1
4-3.	General Description	4-1
4-5.	RF Generator Section, Model 608E	4-1
4-7.	RF Generator Section, Model 608F	4-1
4-9.	Amplitude Modulation Section	4-1
4-15.	Attenuator Section	4-2
4-17.	Calibrator Section	4-3
4-19.	Modulation Meter Section	4-3
4-21.	Power Supply Section	4-3
4-23.	Detailed Description	4-3
4-25.	RF Generator Section, Model 608E	4-3
4-33.	RF Generator Section, Model 608F	4-4
4-37.	Amplitude Modulation Section	4-5
4-51.	Attenuator Section	4-7
4-55.	Calibration Section	4-7
4-59.	Modulation Meter Section	4-7
4-63.	Power Supply Section	4-8
V	MAINTENANCE	5-1
5-1.	Introduction	5-1
5-3.	Periodic Inspection	5-1
5-4.	Cleaning	5-1
5-6.	Lubrication	5-1
5-9.	Performance Tests	5-1
5-10.	Purpose	5-1
5-12.	Frequency Accuracy and Resettability Test	5-1
5-13.	Calibrator Accuracy Test	5-5
5-14.	Frequency Drift Test	5-5
5-15.	Residual FM Test	5-5
5-16.	Incidental FM Test	5-7
5-17.	Maximum RF Output Test	5-7
5-18.	Frequency Response and Leveling Test	5-8
5-19.	RF Output Accuracy Test	5-8
5-20.	Uncalibrated RF Output Test	5-8
5-21.	External Sine-Wave Modulation and Modulation Meter Test	5-8
5-22.	Internal Modulation Test	5-9
5-23.	Envelope Distortion Test	5-9
5-24.	External Pulse Modulation and Residual Level Test	5-10
5-25.	RF Leakage Test	5-10
5-26.	Frequency Control Input Test (Model 608F Only)	5-11
5-27.	Frequency Analog Output Test (Model 608F Only)	5-12
5-28.	Synchronization Test with Model 8708A Synchronizer (Model 608F)	5-12
5-29.	Adjustment	5-12
5-31.	Power Supply Voltage Adjustments	5-13
5-34.	Modulation Meter Adjustment	5-13
5-37.	Calibration of Percent Modulation Meter	5-14
5-41.	Automatic Output Leveling Adjustment	5-15
5-42.	RF Oscillator Adjustment	5-15
5-43.	Uncalibrated RF Output, Minimum RF Output, and RF Amplifier Tracking Adjustment	5-16
5-44.	RF Output Meter Accuracy Adjustment	5-16
5-46.	RF Output Meter/Attenuator Frequency Response and Automatic-Leveling Output Adjustment	5-17
5-47.	Crystal Calibrator Adjustment	5-17
5-48.	Troubleshooting	5-18
5-50.	Isolating a Trouble to a Circuit Section	5-18
5-54.	Isolating Trouble in Transistor Circuits	5-23
5-59.	Replacement and Repair	5-23
5-62.	Etched Circuit Board Repair	5-23
5-63.	Component Replacement	5-25
5-64.	Etched Conductor Repair	5-25
5-66.	Transistor and Semiconductor Diode Replacement	5-26
5-67.	Replacement of Electron Tubes	5-26
5-74.	Attenuator Probe Repair and Replacement	5-29
5-82.	Replacement in Housing	5-30
5-83.	Replacement of Lamp DS1	5-32
5-85.	Location of Parts	5-32

TABLE OF CONTENTS (Cont.)

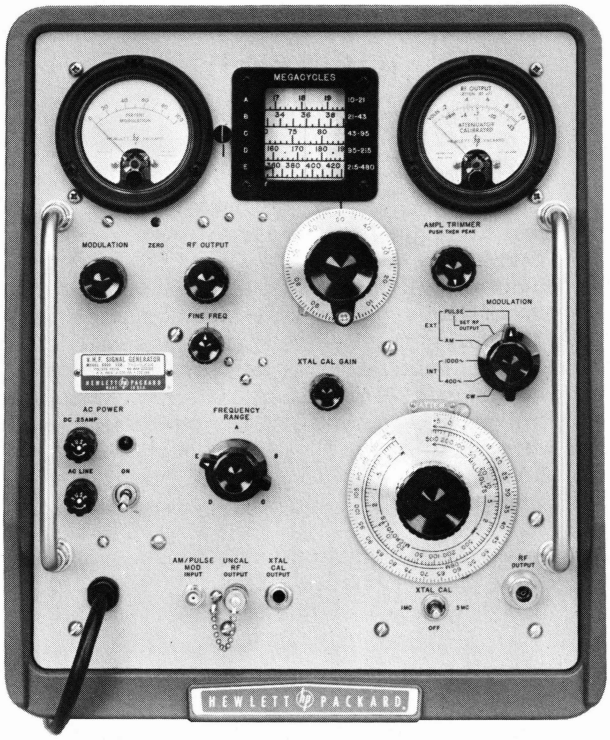
Section		Page
VI	REPLACEABLE PARTS	6-1
	6-1. Introduction	6-1
	6-3. Ordering Information	6-1
VII	SCHEMATIC DIAGRAMS COMPONENT LOCATION INFORMATION	7-1
	7-1. Introduction	7-1
	APPENDIX I	I-1
	APPENDIX II	II-1

LIST OF ILLUSTRATIONS

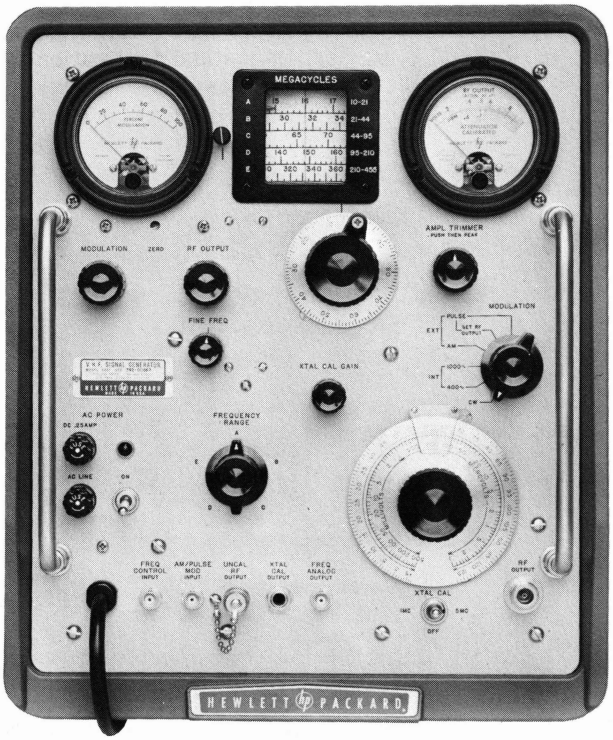
Number	Title	Page
1-1.	Model 608E and 608F VHF Signal Generators	1-0
3-1.	Front Panel Controls, Indicators, and Connectors	3-2
3-2.	Controls, Indicators and Connectors Used in Operation with Internally Generated Signals	3-6
3-3.	Controls, Indicators and Connectors Used in Operation with Externally Supplied Signals	3-8
3-4.	Controls, Indicators, and Connectors Used in Phase-Lock Operation (Model 608F Only)	3-10
4-1.	Overall Block Diagram, Models 608E and 608F	4-0
5-1.	Fabricated Test Equipment	5-3
5-2.	Lubrication Points, RF Tuner Drive Mechanism	5-4
5-3.	Frequency Accuracy and Resettability Test Setup	5-5
5-4.	Residual and Incidental FM Test Setup	5-6
5-5.	RF Output Test Setup	5-7
5-6.	Uncalibrated RF Output Test Setup	5-8
5-7.	External Sine-Wave Modulation and Modulation Meter Test Setup	5-9
5-8.	Envelope Distortion Test Setup	5-10
5-9.	Pulse Modulation Test Setup	5-10
5-10.	RF Leakage Test Setup	5-11
5-11.	Frequency Control Input Test Setup	5-11
5-12.	Synchronization Test Setup	5-12
5-13.	Location Power Supply and Modulation Meter Adjustments	5-13
5-14.	Modulation Meter Calibration Test Setup	5-14
5-15.	Pattern on 140 Oscilloscope at 50% modulation	5-14
5-16.	Location of Leveling and RF Output Meter Adjustment	5-15
5-17.	Location of RF Oscillator Adjustment	5-16
5-18.	Frequency-Response Adjustments	5-18
5-19.	Location of Frequency-Response and Crystal-Calibrator Adjustments	5-18
5-20.	Voltage and Resistance Measure INT 1000 ~ Operation	5-19
5-21.	ALC Board Voltage and Resistance Measurements, CW and PULSE SET RF OUTPUT Operation	5-22
5-22.	Transistor Biasing and Operating Characteristics	5-24
5-23.	Location of Electron Tubes	5-28
5-24.	Replacement of Oscillator and Amplifier Tubes	5-29
5-25.	Disassembly of Attenuator Drive Cable	5-30
5-26.	Attenuator Probe, Showing Pickup Loop and Impedance Matching Network	5-31
5-27.	RF Generator Assembly Location of Unlabeled Parts (Side Cover Removed)	5-32
5-28.	Model 608E RF Generator Assembly Showing Location of Unlabeled Parts (Top Cover Removed)	5-33
5-29.	Model 608F RF Generator Assembly Showing Location of Unlabeled Parts (Top Cover Removed)	5-34
5-30.	Right Side View Showing Location of Unlabeled Chassis Components	5-35
5-31.	Left Side View Showing Location of Unlabeled Components	5-36
5-32.	Rear View Showing Location of Unlabeled Chassis Components	5-37
5-33.	Circuit Board Parts Identification	5-38
7-1.	Schematic Information Illustration	7-1
7-2.	Schematic Diagram Notes	7-2
7-3.	Component Identification, Modulator and ALC Board	7-3
7-4.	RF Generator and Modulator Schematic Diagram	7-3
7-5.	Modulation Meter, Crystal Calibration, and Power Supply Schematic Diagram	7-5

LIST OF TABLES

Number	Title	Page
1-1.	Specifications	1-2
5-1.	Test Equipment Required for Maintenance	5-2
5-2.	Lubrication Chart	5-4
5-3.	Out-of-Circuit Transistor Resistance Measurement	5-25
5-4.	Safe Ohmmeter Ranges for Transistor Resistance Measurement	5-25
5-5.	Etched Circuit Soldering Equipment	5-26
5-6.	Checks Following Tube and Semiconductor Replacement	5-27
5-7.	608E/F Troubleshooting Procedure	5-40
6-1.	Reference Deisgnation Index	6-2
6-2.	Replaceable Parts	6-12
6-3.	Code List of Manufacturers	6-17



Model 608E



Model 608F

Figure 1-1. Model 608E and 608F VHF Signal Generators

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 608E and 608F Signal Generators (see Figure 1-1) are designed to meet the requirements of precision laboratory work, and yet to be equally useful for general applications in the VHF frequency range. The Model 608E furnishes RF signals from 0.1 microvolt to 1 volt from 10 MHz to 480 MHz, while the Model 608F supplies RF signals from 0.1 microvolt to 0.5 volt in a frequency range from 10 MHz to 455 MHz. The RF carrier can be amplitude modulated by internally generated sine-wave signals, or by externally supplied sine-wave or pulse signals. The Model 608F contains frequency control circuitry which permits the instrument to be used in phase-lock operation with the Model 8708A Synchronizer. This provision provides a stabilized output across most of the range of the instrument, with a drift factor of 2×10^{-7} in 10 minutes. The instruments can be used for troubleshooting, testing, calibrating, measuring standing-wave ratios, and checking antenna and transmission line characteristics. To preserve accuracy, equipment design holds spurious modulation to a low value under all operating conditions. Detailed specifications for both instruments are listed in Table 1-1.

1-3. FREQUENCY.

1-4. The frequency of the output signal is indicated on a direct-reading dial, the calibration of which is accurate to better than ±0.5% for the 608E and ±0.1% for the 608F, when the cursor and FINE FREQ adjustments are properly aligned. Calibration accuracy may be improved further by use of a built-in crystal-controlled heterodyne calibrator which furnishes 1 MHz checkpoints from 10 MHz to 270 MHz, or 5 MHz checkpoints over the entire frequency range of the instrument. At any checkpoint the calibration can be set very close to the calibrator accuracy of 0.01%, bringing overall accuracy to at least ±0.05%. Frequency check point signals are obtained when a headphone set (not furnished) is plugged into the XTAL CAL OUTPUT jack. The control for the output attenuator is calibrated in both decibels and volts. When the instrument is connected to a 50-ohm resistive load and power into the output attenuator is exactly at the ATTENUATOR CALIBRATED mark (+7 dB) on the RF OUTPUT meter, the level of power or voltage applied to the RF OUTPUT connector may be read directly on the ATTENUATOR dial with an accuracy of ±1 dB. When connected to a 50-ohm resistive load, the VSWR at the RF OUTPUT connector will not be greater than 1.2 (SWR of 1.6 dB). The signal generators feature automatic output leveling, maintaining the RF output within ±1 dB of the adjusted output.

1-5. MODULATION.

1-6. The RF output signal can be amplitude modulated by internally generated 400 or 1000-cycle sine waves, externally applied sine waves above 1.0 volt rms over the frequency range from 20 Hz to 20 kHz, or externally applied pulses of 10 volts peak-to-peak. When pulse modulated, the signal generators are capable of producing pulses of RF energy as short as 4 microseconds at signal frequencies above 40 MHz, and pulses as short as 2 microsecond above 220 MHz. The degree of sine-wave modulation is continuously variable from 0 to 90% by a front-panel control. All sine-wave modulation of the output signal is continuously monitored and indicated in percentage on a direct reading modulation meter.

1-7. RFI.

1-8. RF leakage is held to a minimum and is such that when the output signal is adjusted for 0.1 microvolt, the conducted signal leakage at any other front panel connector and the radiated leakage two inches from the instrument are each less than 1.0 microvolt.

1-9. AUXILIARY EQUIPMENT.

1-10. MODEL 11509A FUSEHOLDER.

1-11. To protect the output attenuator from damage, for some applications (such as transceiver testing) it is desirable to insert a fuse between the signal generators and external equipment. The 11509A is a special coaxial fuseholder which houses a type 8AG, 1/16 amp fuse which protects the output attenuator from damage in the event that an external voltage is accidently applied to the RF OUTPUT connector. The fuseholder has an insertion loss of 0.50 dB at 200 MHz, 0.56 dB at 300 MHz, and 0.65 dB at 400 MHz; its SWR is not greater than 1.35 when connected to a 50-ohm resistive load.

1-12. MODEL 11508A TERMINATED OUTPUT CABLE.

1-13. This cable assembly provides a 50-ohm termination and standard binding posts at the end of a 24-inch length of cable. The 11508A allows direct connection of the instruments to a high-impedance circuit.

1-14. INSTRUMENT IDENTIFICATION.

1-15. Hewlett-Packard instruments carry a two-section, eight-digit serial number. The first three digits are a prefix. The contents of this manual apply to those instruments having the serial number prefix shown on the title page. If the serial prefix on your instrument is not mentioned on the title page, in the Appendix to this manual, or in a Manual Change Sheet enclosed with the manual, the correct information may be obtained from any Hewlett-Packard Sales and Service Office (see rear of manual for addresses).

Table 1-1. Specifications

FREQUENCY CHARACTERISTICS

608E

Range: 10 to 480 MHz in five bands (10-21, 21-43, 43-95, 95-215, and 215-480 MHz).

Accuracy: ±0.5%.

Drift: Less than 50 parts in 10^6 per 10 min. period after 1 hr. warmup.

608F

Range: 10 to 455 MHz in five bands (10-21, 21-44, 44-95, 95-210, and 210-455 MHz). 10-430 MHz when used with 8708A Synchronizer.

Accuracy: ±1%.

Drift: Less than 50 parts in 10^6 per 10 min. period after 1 hr. warmup. Stability used with 8708A Synchronizer.

5×10^{-8}/min.

2×10^{-7}/min.

(0°-55°C)

2×10^{-7}/10% line voltage change.

Tuning Control: Frequency control mechanism provides a main dial calibrated in MHz and a vernier dial for interpolation purposes. Total scale length approximately 45 inches. Calibration: every other MHz from 130 to 270 MHz; every 5 MHz above 270 MHz.

Resettability: Main frequency control resettability better than ±0.1% after initial warmup. FINE FREQUENCY ADJUST provides approximately ±25 kHz settability at 480 MHz (proportionately finer adjustment at lower frequencies).

Crystal Calibrator: Provides frequency check points every 1 MHz up to 270 MHz or every 5 MHz over the range of the instrument. Headphone jack provided for audio frequency output (headphones not included). Crystal frequency accuracy better than 0.01% at normal room temperatures. Cursor on frequency dial adjustable over small range to aid in interpolation adjustment. Calibrator may be turned off when not in use.

Residual FM: Less than ±5 parts in 10^7.

Harmonic Output: At least 35 dB below the carrier for harmonic frequencies below 500 MHz.

Frequency Control Input: (608F only). The 608F FREQ CONTROL INPUT normally used with the 8708A Synchronizer can also be used for external frequency control by varying a dc voltage input. A voltage change from -2 volts to -32 volts will change the output frequency more than 0.2% at the low end of each band and more than 1% at the high end of each band. Nominal 4 KΩ input impedance, direct coupled. Voltage limits: 0V ≤ applied voltage ≤ -50V.

OUTPUT CHARACTERISTICS

608E

Output Level: Continuously adjustable from 0.1 μV to 1V into a 50Ω load. Output attenuator calibrated in V and dBm (0 dBm = 1 mW in 50Ω).

608F

Output Level: Continuously adjustable from 0.1 μV to 0.5V into a 50Ω load. Output attenuator calibrated in V and dBm (0 dBm = 1 mW in 50Ω).

Accuracy: Within ±1 dB of attenuator dial reading at any frequency when RF output meter indicates "ATTENUATOR CALIBRATED."

Leveling: Internal feedback circuit retains "ATTENUATOR CALIBRATED" reference on RF output meter over wide frequency ranges (typically octave bands). Adjustment of front panel AMP. TRIMMER control (only) for maximum RF output indication automatically restores initial carrier level for greater frequency changes.

Impedance: 50Ω; reflection coefficient ≤0.091 (1.2 SWR, 20.8 dB return loss) for attenuator setting below -7 dBm.

RFI: Meets all conditions specified in MIL-I-6181D; permits receiver sensitivity measurements down to at least 0.1 μV.

Auxiliary RF Output:

608E

Fixed level CW signal from RF oscillator (minimum amplitude 180 mV rms into 50Ω) provided at front panel BNC female connector for use with external equipment (e.g., frequency counter).

608F

CW signal from RF Oscillator provided at front panel BNC female connector. Power levels into 50Ω are as follows:

10 to 215 MHz: +1.8 to +7 dBm
215 to 400 MHz: +2.0 to +6 dBm
400 to 430 MHz: +1.0 to +5 dBm

Signal for use with HP 8708A Synchronizer or other external equipment (e.g., frequency counter).

Table 1-1. Specifications (Cont.)

MODULATION CHARACTERISTICS

(Front-panel AMP. TRIMMER control adjusted for maximum indication of RF Output Meter and RF Output Meter set to Attenuator Calibrated.)

Internal AM

Frequency: 400 and 1000 Hz, ±10%. Modulation signal available at front panel BNC female connector for synchronization of external equipment.

608E	608F
Modulation Level: 0 to 95% modulation at carrier levels 0.5 V and below; continuously adjustable with front-panel MOD LEVEL control.	Modulation Level: 0 to 95% modulation with Output Attenuator at 0.224 V (1 mW) or below; continuously adjustable with front-panel MOD LEVEL control.

Carrier Envelope Distortion: Less than 2% at 30% AM and less than 5% at 70% AM.

External AM

Frequency: 20 Hz to 20 kHz.

608E	608F
Modulation Level: 0 to 95% modulation at carrier levels 0.5 V and below; continuously adjustable with front-panel MOD LEVEL control. Input required: 1 to 10 V rms (1 k Ω input impedance).	Modulation Level: 0 to 95% modulation with Output Attenuator at 0.224 V (1 mW) or below; continuously adjustable with front-panel MOD LEVEL control. Input required: 1 to 10 V rms (1 k Ω input impedance).

Carrier Envelope Distortion: Less than 2% at 30% AM, less than 5% at 70% AM (modulation source distortion less than 0.5%).

External control of carrier level can be achieved through application of dc voltage in EXT AM mode.

Modulation Meter

Accuracy: ±5% of full scale 0 to 80%, ±10% from 80% to 95% (for INT AM or 20 Hz to 20 kHz EXT AM).

Incidental Frequency Modulation (at 400 and 1000 Hz modulation)

Less than 1000 Hz peak at 50% AM for frequencies above 100 MHz. For frequencies below 100 MHz, less than 0.001% at 30% AM.

External Pulse Modulation

Rise and Decay Time: From 40 MHz to 220 MHz, combined rise and decay time less than 4 μs. Above 220 MHz, combined rise and decay time less than 2.5 μs.

On-Off Ratio: At least 20 dB for pulsed carrier levels of 0.5 V and above.

Input Required: Positive pulse, 10-50 V peak; input impedance 2 k Ω.

GENERAL

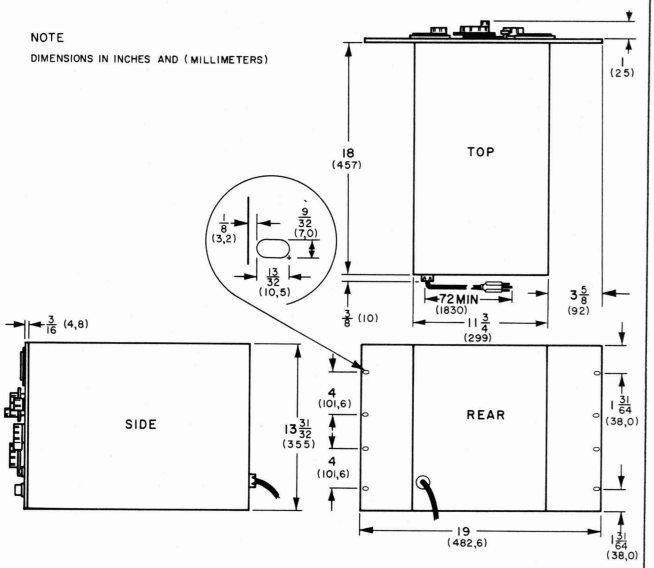
608E and 608F

Power: 115 or 230 V ±10%, 50 to 400 Hz. Approximately 220 W.

Dimensions

Cabinet Mount: 13-1/4 in. (337 mm) wide, 16-3/4 in. (416 mm) high, 21 in. (533 mm) deep.

Rack Mount:



Weight

Cabinet Mount: Net, 62 lb (28 kg). Shipping, 74 lb (33, 4 kg).

Rack Mount: Net, 62 lb (28 kg). Shipping, 83 lb (37, 4 kg).

Accessories Available

11508A Output Cable provides 50-Ω termination and standard binding posts at the end of a 24-inch (610 mm) length of cable. Allows direct connection of the signal generator to high impedance circuits.

11509A Fuse Holder provides protection for the output attenuator when the 608 is used for transceiver tests.

10514A Mixer for use as nanosecond pulse modulator or balanced modulator.

10515A Doubler for extending the frequency range.

SECTION II

INSTALLATION

2-1. INCOMING INSPECTION.

2-2. This instrument was inspected mechanically and electrically prior to shipment. Inspect for mechanical damage received in transit and test electrical performance using procedures given in Section V. If there is damage or deficiency, or if electrical performance is not within specifications, notify the carrier and your Hewlett-Packard Sales and Service Office immediately (see list at rear of this manual.)

2-3. PREPARATION FOR USE.

2-4. POWER REQUIREMENTS.

2-5. The VHF Signal Generator requires a power source of 115 or 230 volts ac ±10%, single phase, which can supply approximately 220 watts. A two-position slide switch, on the inside rear chassis, permits operation from either a 115- or 230-volt power source. The number visible on the switch slider indicates the line voltage for which the signal generator is connected. The correct fuse rating for each line voltage is adjacent to the switch. To prepare the signal generator for operation, position the 115-230 volt switch so that the number visible on the slider corresponds to the available line voltage, and install a fuse of correct rating (marked on rear apron).

CAUTION

Before connecting the power cable, set the 115-230 volt switch for the line voltage to be used.

2-6. POWER CABLE.

2-7. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptable, grounds the instrument. The off-set pin of the three-prong connector is the ground pin. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter (Hewlett-Packard Stock No. 1251-0048) and connect the green pigtail on the adapter to ground.

2-8. REPACKING FOR SHIPMENT.

2-9. If the signal generator is to be packaged for shipment use the original shipping container and packing materials. If these have been discarded or are not in condition for reuse, obtain new materials from your local Hewlett-Packard Sales and Service Office (see rear of this manual for locations), or follow these general instructions:

a. Wrap the signal generator in heavy paper or plastic. (If the signal generator is being shipped to a Hewlett-Packard service facility, attach a tag indicating type of servicing required, return address, model number, and full serial number.)

b. Use a strong shipping container. A carton made of 500-600 pound test material will usually provide adequate protection.

c. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard. With Hewlett-Packard "floater pack" packaging, the foam blocks provide sufficient shock protection, and additional material is unnecessary.

d. Seal the shipping container securely.

e. Mark the shipping container "FRAGILE" to assure careful handling.

2-10. In any correspondence refer to the signal generator by model number and full serial number.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section provides operating instructions for the Model 608E and 608F Signal Generators. Included are a listing of controls, indicators and connectors, pre-operation procedures, mode operating procedures, and phase-lock operation procedures (Model 608F only). Controls and indicators on both instruments are nearly identical; therefore, an illustration of the Model 608F will be referenced during this discussion, with the difference between instruments identified.

3-3. CONTROLS, INDICATORS AND CONNECTORS.

3-4. Except for the 115/230 volt power switch, all controls, indicators, and connectors are located on the front panel. Figure 3-1 locates and provides a functional description of each front-panel mounted control, indicator and connector. The 115-230 volt power switch is located inside the rear panel and is not shown.

3-5. PRE-OPERATION PROCEDURES.

3-6. Prior to use, certain procedures must be completed to obtain maximum accuracy during operation of the instrument. Consideration must be given to the possibility of RF loading, and calibration of the instrument is required. During the following discussion, each control used will be identified by an item number that is referenced to Figure 3-1.

3-7. RF OUTPUT LOADING.

CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the signal generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inactive while the equipment is connected to the signal generator.

NOTE

To protect the Attenuator when there is a possibility of voltage being applied to the RF OUTPUT connector, a Model 11509A Fuseholder is recommended. The fuseholder is connected between the test cable and RF OUTPUT connector.

3-8. A resistive load of 50 ohms is used at the factory during calibration of the Attenuator Control dial. Therefore, for an accurate indication of output power the external load should be 50 ohms resistive. The internal impedance of the generator is close to 50 ohms, with a maximum VSWR of 1.2 existing when the generator is terminated in 50 ohms. This VSWR will have no important effect on the accuracy of the Attenuator Control calibration. However, a severe mismatch between the instrument and load will produce a considerable difference between the output voltage selected on the Attenuator Control dial and the actual voltage impressed across the external load. Particular care should be exercised in the selection of coaxial connectors. A coaxial connector that has been improperly assembled can produce a substantial increase in the standing-wave ratio.

3-9. TURN-ON PROCEDURES.

3-10. Turn-on procedures for the signal generator are as follows:

CAUTION

Do not obstruct the ventilating louvers on the side of the instrument cabinet. Safe operating temperature requires free air flow through the louvers.

a. Set AC POWER switch (item 12) to the OFF position.

b. Check position of 115-230 volt power switch (refer to paragraph 2-5) on rear of chassis.

c. Set MODULATION selector switch (item 20) to CW position.

d. Set RF OUTPUT control (item 5) to near maximum position (clockwise).

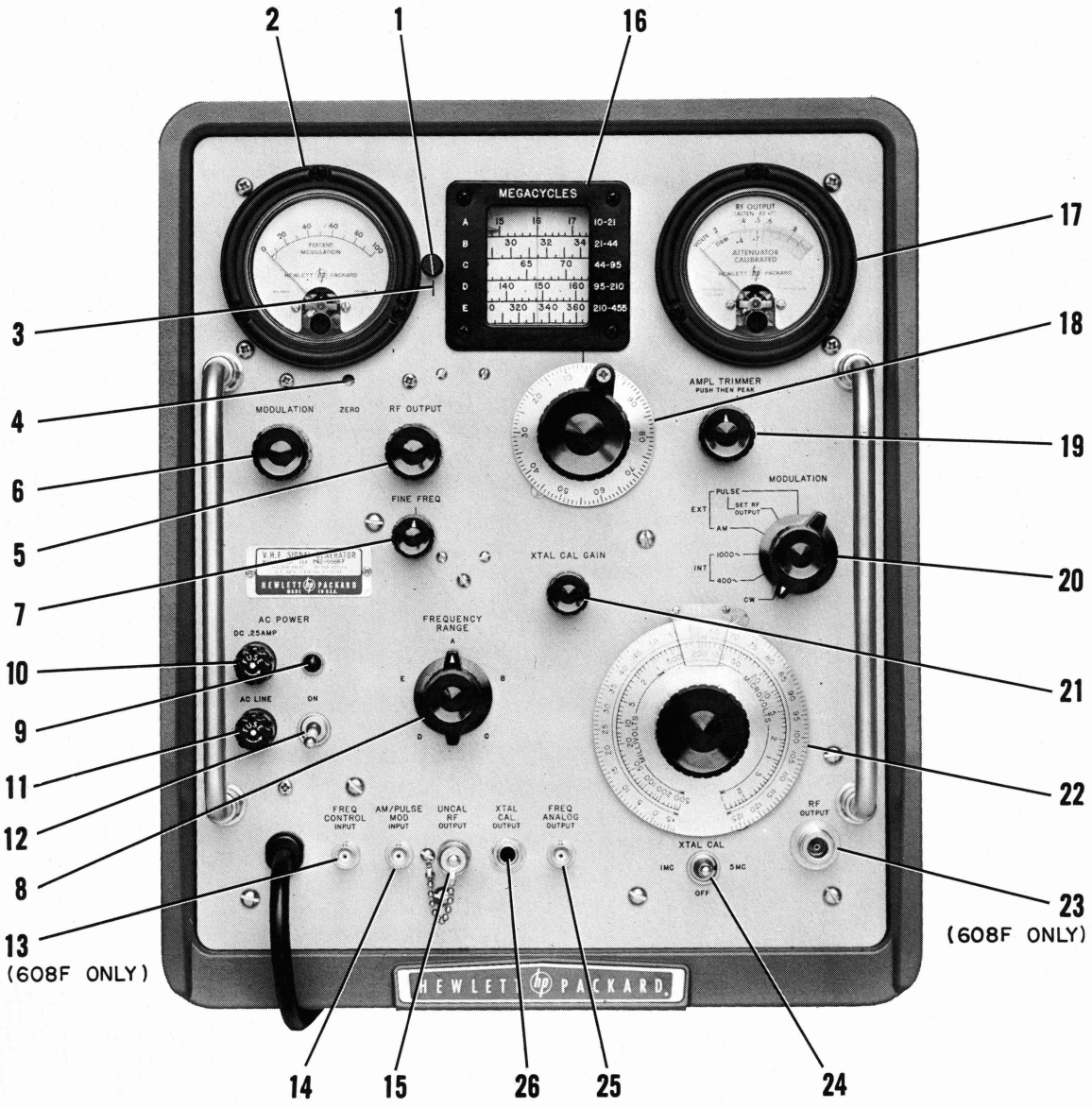
e. Set AC POWER switch to ON position.

f. Warmup equipment for 10 minutes prior to use. If greater frequency stability is required, extend warmup period to 60 minutes.

3-11. CALIBRATION PROCEDURES.

3-12. Prior to operation certain calibration of the instrument may be deemed necessary. The following discussion contains frequency and power output calibration procedures.

3-13. FREQUENCY CALIBRATION. The frequency (MEGACYCLES) dial in the signal generators are calibrated to be accurate within ±0.5% for the 608E and ±0.1% for the 608F. To obtain higher accuracy,



1. Cursor knob: Positions cursor on the MEGACYCLES (frequency) dial.
2. PERCENT MODULATION meter: Indicates the percent of modulation of the RF output signal.
3. Panel marker: Scribed mark for cursor alignment.
4. ZERO control: Screwdriver adjustment to electrically zero the PERCENT MODULATION meter.
5. RF OUTPUT control: Controls RF power input to the attenuator. Also controls output power levels between +7 dBm and +13 dBm in the Model 608E.

Figure 3-1. Front Panel Controls, Indicators, and Connectors

6. MODULATION control: Adjusts the percent of modulation of the RF output signal as observed on the PERCENT MODULATION meter.

7. FINE FREQ control: Used for fine frequency adjustments

8. FREQUENCY RANGE switch: Five-position switch used to select the desired frequency range. Also positions the range pointer on the dial. Switch positions are as follows:

RANGE	MODEL 608E	MODEL 608F
A	10-21 MHz	10-21 MHz
B	21-43 MHz	21-44 MHz
C	43-95 MHz	44-95 MHz
D	95-215 MHz	95-210 MHz
E	215-480 MHz	210-455 MHz

9. AC POWER lamp: Indicates when ac power is applied to the instrument.

10. DC .25 AMP fuse: Overload protective device for the +225 Vdc power supply.

11. AC LINE fuse: Protective device between the instrument and the ac power source.

12. AC POWER ON switch: Controls application of ac power to the instrument.

13. FREQ CONTROL INPUT connector (Model 608F only): Input connector for the dc control voltage when the instrument is used with a Model 8708A Synchronizer.

14. AM/PULSE MOD INPUT connector: Input connector for AM or pulse signals during external sine-wave or pulse operation. During internal sine-wave modulation, a 400 or 1000 Hz signal is available at the connector for synchronizing external equipment.

15. UNCAL RF OUTPUT connector: Output connector in the 608E delivers an uncalibrated, unmodulated RF signal to external equipment. In the Model 608F used with the Model 8708A Synchronizer, output connector delivers an uncalibrated FM signal.

16. MEGACYCLES dial: Indicates selected frequency range and frequency in MHz.

17. RF OUTPUT meter: Indicates level of RF power applied to the attenuator as selected by operation of the RF OUTPUT control. Also used in conjunction with the AMPL TRIMMER control to peak the RF output signal.

18. Frequency control: Used to select the output frequency within a frequency range as observed on the MEGACYCLES dial.

19. AMPL TRIMMER control: A two-function control for peaking the RF output. During pulse modulation, the control is tuned without pushing to peak the RF output. When sine-wave or CW operations are conducted, the control is pushed and then tuned.

20. MODULATION switch: A six-position switch that sets the instrument mode of operation. The switch positions are identified as follows:

    PULSE: Sets the instrument for external pulse modulation.

    PULSE SET RF OUTPUT: Used to establish the instrument operating point for external pulse modulation.

    AM: Sets the instrument for external sine-wave modulation.

    1000 ~ : Sets the instrument for internal AM modulation at 1000 Hz.

    400 ~ : Sets the instrument for internal AM modulation at 400 Hz.

    CW: Sets the instrument to provide a CW output.

21. XTAL CAL GAIN control: Controls audio level of beat-frequency output at the XTAL CAL OUTPUT connector.

22. Attenuator control: Controls RF output levels of +7 dBm and below. Output levels selected by use of the Attenuator Control are accurate as long as the RF OUTPUT meter needle indicates +7 dBm (ATTENUATOR CALIBRATED).

23. RF OUTPUT connector: Output connector for the calibrated RF signal (refer to CAUTION, paragraph 3-7).

24. XTAL CAL switch: Three-position toggle switch used when performing frequency calibrations. Switch positions are as follows:

    1 MC: Provides 1 MHz checkpoints from 10 to 270 MHz.

    5 MC: Provides 5 MHz checkpoints from 10-480 MHz in the Model 608E and from 10-455 MHz in the Model 608F.

    OFF: De-energizes oscillator circuits.

25. FREQ ANALOG OUTPUT connector (Model 608F only): Delivers a resistance proportional to frequency to the Model 8708A Synchronizer during phase-lock operation.

26. XTAL CAL OUTPUT connector: Supplies calibrating signals to an operator for frequency calibration. Accommodates an earphone plug.

Figure 3-1. Front Panel Controls, Indicators, and Connectors (Cont.)

a crystal-controlled calibrator has been included to provide a means of calibrating the instrument at any multiple of 1 MHz between 10 and 270 MHz, or any multiple of 5 MHz across the frequency range of the instrument. Procedures to crystal-calibrate the instrument are as follows:

a. Conduct turn-on procedures listed in paragraph 3-9.

b. Connect headphones (not supplied) to the XTAL CAL OUTPUT connector (item 26).

c. Set XTAL CAL switch (item 24) to 1 MC or 5 MC as applicable.

d. Rotate frequency control (item 18) until MEGACYCLES dial (item 16) is set on the 1 MHz or 5 MHz checkpoint nearest the frequency to be used.

e. Adjust XTAL CAL GAIN control (item 21) for a comfortable audio level in headphones.

f. Slowly rotate frequency control around the selected checkpoint until a null (zero beat) is reached.

g. Rotate Cursor Knob (item 3) until cursor is aligned on MEGACYCLES dial with zero-beat point achieved in step f.

h. Rotate frequency control until selected frequency on MEGACYCLES dial appears directly under cursor.

i. Set XTAL CAL switch to OFF.

3-14. A FINE FREQ control (item 7) is located on the instrument front panel for making minor frequency adjustments. During normal operation no adjustment of the FINE FREQ control is required, and the knob arrow should be aligned with the front-panel marker. For a precision frequency selection using a frequency counter, the FINE FREQ control is used after the frequency has been selected by use of the frequency control. Tuning the knob arrow counterclockwise from the panel marker lowers the frequency, while a clockwise rotation raises the frequency.

3-15. POWER OUTPUT CALIBRATION. The RF leveling circuit in the instrument maintains a flat RF output over wide frequency ranges with proper initial adjustments. These adjustments are conducted using the RF OUTPUT and AMPL TRIMMER controls in conjunction with the RF OUTPUT meter. The take-off point for the detected RF signal displayed on the RF OUTPUT meter is at the input circuit of the attenuator. Therefore, calibrating the RF output into the attenuator ensures that subsequent operation of the attenuator control will produce an accurate calibrated RF output from the attenuator. RF output calibration procedures are as follows:

a. Conduct turn-on procedures listed in paragraph 3-9.

b. Set the MODULATION switch (item 20) to the CW position.

NOTE

For maximum accuracy, power output calibrations should be conducted with the instrument set in the CW Mode.

c. Set the FREQUENCY RANGE switch (item 8) to the desired range.

d. Tune the frequency control (item 18) five turns in from the low end of the selected frequency range as indicated on the MEGACYCLES dial (item 16).

e. Adjust the RF OUTPUT control (item 5) for an indication on the RF OUTPUT meter (item 17).

f. Depress the AMPL TRIMMER control (item 19) and tune for a peak RF indication on the RF OUTPUT meter.

g. Readjust the RF OUTPUT control until the RF OUTPUT meter pointer is aligned with the +7 dBm (ATTENUATOR CALIBRATED) mark.

NOTE

To calibrate range "E" tune to top of band and repeat steps e through g, before proceeding on to step h.

h. Tune the frequency control across the selected frequency range. The RF OUTPUT meter pointer should remain aligned with the ATTENUATOR CALIBRATED mark.

NOTE

If the pointer does not remain aligned with the ATTENUATOR CALIBRATED mark, the leveling circuit is not functioning properly. Stop tuning and readjust the AMPL TRIMMER control to restore leveling. The latter adjustment is made without depressing the control.

i. Proceed with operating adjustments listed in paragraphs 3-18 and 3-20.

3-16. MODE OPERATING PROCEDURES.

3-17. The signal generators have four operating modes identified as CW operation, internal sine-wave modulation, external sine-wave modulation, and external pulse modulation. In addition, the RF output level established for CW operation can be remotely controlled by an externally supplied dc control voltage. The following discussion combines locally controlled CW operation and internal sine-wave modulation into operating instructions used with internally generated signals, external sine-wave modulation, external pulse modulation and remote-controlled CW operation. These operating procedures are used with externally supplied signals.

3-18. INTERNAL MODULATION.

3-19. The signal generators provide internal facilities to produce a CW output, or selection of either a 400 Hz or 1000 Hz sine-wave modulated signal output. Figure 3-2 illustrates and provides instructions for

proper operation of the controls, indicators, and connectors used with internally generated signals.

3-20. EXTERNAL MODULATION.

3-21. The signal generators operate with externally supplied sine-wave or pulse signals, which are used to modulate the internally developed RF carrier. Also, an external dc voltage can be applied to provide remote on-off control of the RF carrier output from the instruments. Figure 3-3 illustrates and describes the operation of controls, indicators, and connectors used in the three operations.

3-22. PHASE-LOCK OPERATING PROCEDURES (MODEL 608F ONLY).

3-23. The RF Generator Section in the Model 608F signal generator is designed for phase-lock operation with the Model 8708A Synchronizer. This method of operation provides a highly stable output from the instrument, and requires only normal control adjustments followed by cable connections between the signal generator and synchronizer. Figure 3-4 illustrates and describes operation of controls, indicators and connectors on the Model 608F when the instrument is used in phase-lock operation.

3-24. Configuration of the RF Generator Section in the Model 608F signal generator also permits the instrument to be used in narrow-band frequency or phase modulation operations. In this application, consideration must be given to the internal bias of -22 volts dc on the FREQ CONTROL INPUT connector, and the input impedance of approximately 5K ohms. (I.E., a blocking capacitor must be added to the input circuit for passing the modulating signal while preventing any change in the reference reverse bias applied to the varicap diodes.)

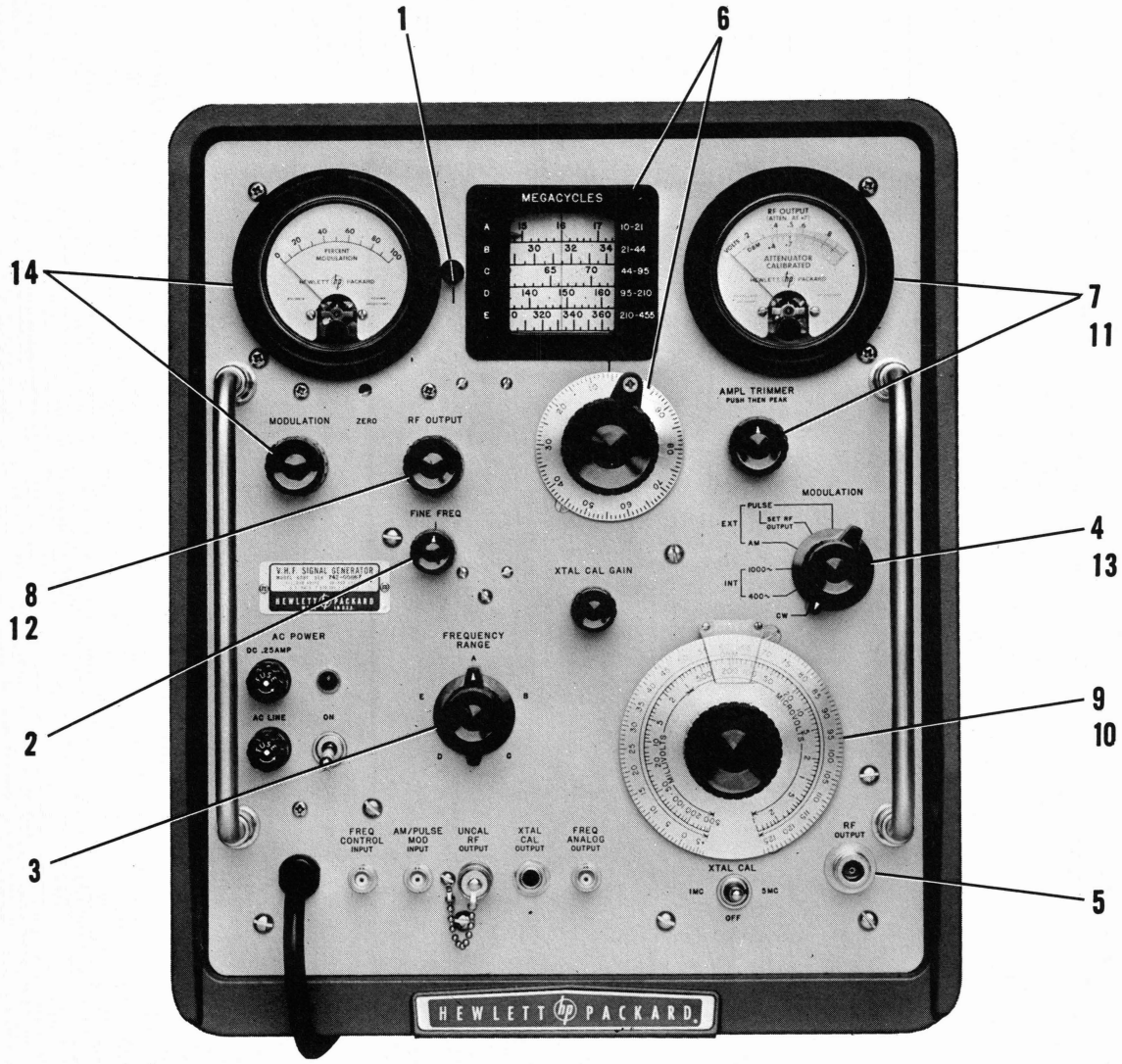


Figure 3-2. Controls, Indicators, and Connectors Used in Operation with Internally Generated Signals

CW OPERATION

NOTE

Perform turn-on procedures listed in paragraph 3-9.

1. Align cursor knob with panel marker.
2. Align FINE FREQ control with panel marker.
3. Set FREQUENCY RANGE switch to desired range (frequency limits for each range shown on MEGACYCLES dial housing).
4. Set MODULATION switch to the CW position.

CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the signal generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inoperative while the equipment is connected to the signal generator (refer to NOTE in paragraph 3-7).

5. Connect the equipment under test to the RF OUTPUT connector observing that the signal generator is terminated in the proper load (refer to paragraph 3-8).

NOTE

If deemed necessary, conduct power output calibration procedures for the selected frequency range as listed in procedural steps d. through h. in paragraph 3-15.

6. Tune the Frequency Control until MEGACYCLES dial cursor is aligned with frequency to be used as indicated on dial face.

NOTE

To crystal calibrate the frequency dial, refer to procedures listed in paragraph 3-13.

7. Depress and tune AMPL TRIMMER control for maximum indication on RF OUTPUT meter.
8. Adjust RF OUTPUT control until RF OUTPUT Meter pointer is aligned with +7 dBm mark (ATTENUATOR CALIBRATED).

NOTE

Accuracy of the Attenuator Control setting and PERCENT MODULATION meter are within specifications only when the RF OUTPUT meter is indicating ATTENUATOR CALIBRATED.

9. Adjust Attenuator Control for desired output level of +7 dBm or below.

NOTE

To select RF output levels from +7 dBm to +13 dBm in the Model 608E, perform steps 10 through 12. In this operation, the RF OUTPUT meter pointer is used in lieu of the Attenuator Control to indicate the power output level.

10. Adjust the Attenuator Control to the +7 dBm dial mark.
11. Check that the RF OUTPUT meter pointer indicates ATTENUATOR CALIBRATED.
12. Adjust RF OUTPUT control for desired output level above +7 dBm as indicated by the RF OUTPUT meter pointer.

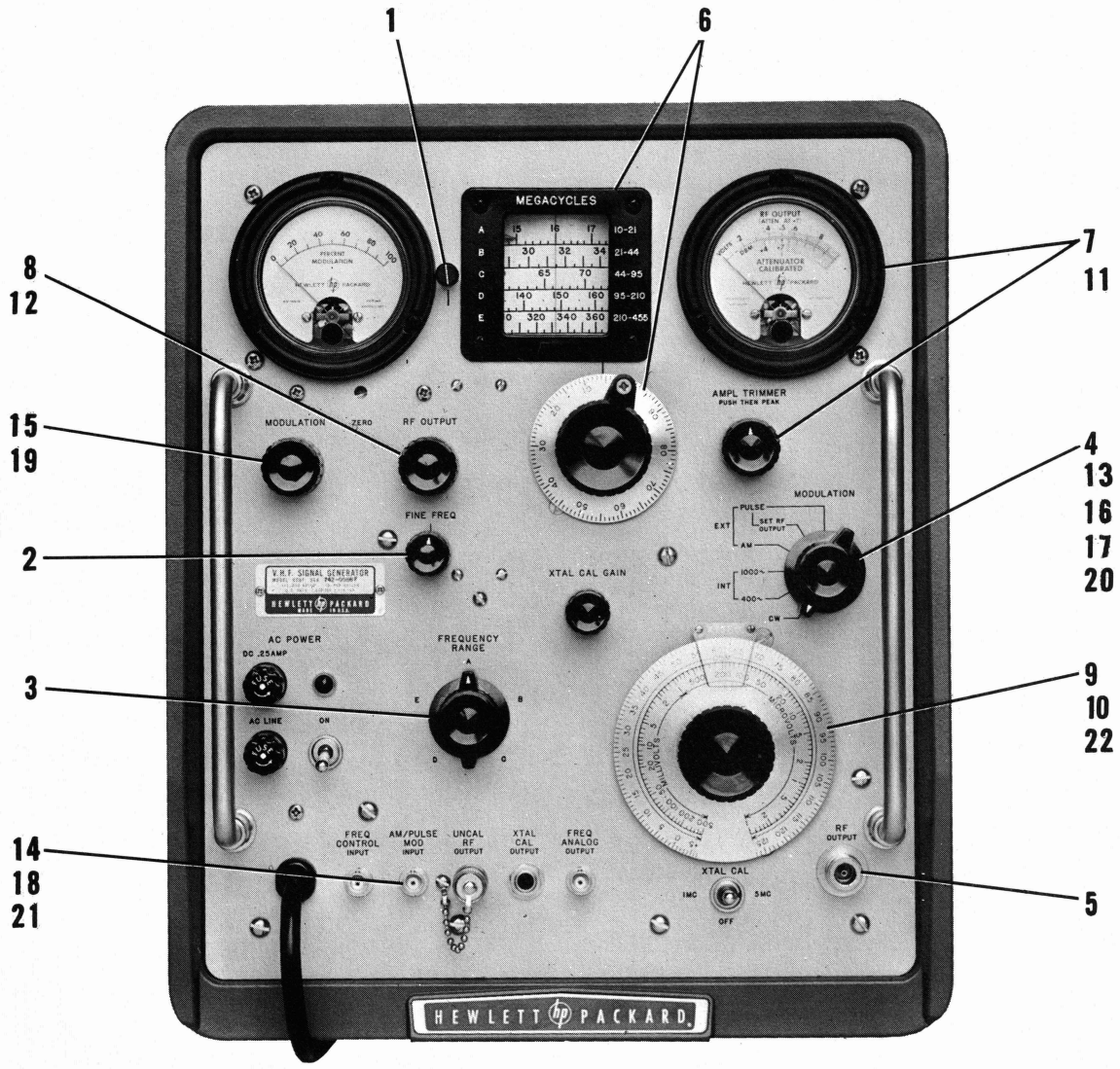
INTERNAL SINE-WAVE MODULATION

NOTE

Steps 1 through 12, as applicable, must be completed before setting the instrument for internal sine-wave AM modulation.

13. Set MODULATION switch to 400 ~ or 1000 ~ position as desired.
14. Adjust MODULATION control for desired modulation percentage as indicated on the PERCENT MODULATION meter.

Figure 3-2. Controls, Indicators and Connectors Used in Operation with Internally Generated Signals (Cont.)



EXTERNAL SINE-WAVE MODULATION

NOTE

Perform turn-on procedures listed in paragraph 3-9.

1. Align cursor knob with panel marker.
2. Align FINE FREQ control with panel marker.
3. Set FREQUENCY RANGE switch to desired range (frequency limits for each range shown on MEGACYCLES dial housing).

Figure 3-3. Controls, Indicators, and Connectors Used in Operation with Externally Supplied Signals

4. Set MODULATION switch to CW position.

CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the signal generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inoperative while the equipment is connected to the signal generator (refer to NOTE in paragraph 3-7).

5. Connect the equipment under test to the RF OUTPUT connector observing that the signal generator is terminated in the proper load (refer to paragraph 3-8).

NOTE

If deemed necessary, conduct power output calibration procedures for the selected frequency range as listed in procedural steps d. through h. in paragraph 3-15.

6. Tune Frequency Control until MEGACYCLES dial cursor is aligned with frequency to be used as indicated on dial face.

NOTE

To crystal calibrate the frequency, refer to procedures listed in paragraph 3-13.

7. Depress and tune AMPL TRIMMER control for maximum indication on RF OUTPUT meter.

8. Adjust RF OUTPUT control until RF OUTPUT meter pointer is aligned with +7 dBm mark (ATTENUATOR CALIBRATED).

NOTE

Accuracy of the Attenuator Control setting and PERCENT MODULATION meter are within specifications only when the RF OUTPUT meter is indicating ATTENUATOR CALIBRATED.

9. Adjust Attenuator Control for desired output level of +7 dBm or below.

NOTE

To select RF output levels from +7 dBm to +13 dBm in the Model 608E, perform steps 10 through 12. In this operation, the RF OUTPUT meter pointer is used to indicate the power output level in lieu of the Attenuator Control.

10. Adjust the Attenuator Control to the +7 dBm dial mark.

11. Check that the RF OUTPUT meter pointer indicates ATTENUATOR CALIBRATED.

12. Adjust the RF OUTPUT control for the desired output level above +7 dBm as indicated by the RF OUTPUT meter pointer.

13. Set the MODULATION switch to the AM position.

14. Connect the external sine-wave generator to the AM/PULSE MOD INPUT connector and set generator for a sine-wave input between 20 Hz and 20 kHz.

15. Set MODULATION control for desired percentage of modulation as observed on the PERCENT MODULATION meter.

EXTERNAL PULSE MODULATION

NOTE

Perform turn-on procedures if required, and complete steps 1 through 3.

16. Set MODULATION switch to the PULSE/SET RF OUTPUT position.

NOTE

Perform steps 5 through 12 as applicable.

17. Set the MODULATION switch to the PULSE position.

18. Connect the external pulse generator to the AM/PULSE MOD INPUT connector and set generator for an input pulse level above 10 volts peak-to-peak.

EXTERNAL DC CONTROL

NOTE

Perform turn-on procedures if required, and complete steps 1 through 8.

19. Set the MODULATION control to a maximum clockwise position.

20. Set MODULATION switch to the AM position.

21. Connect external power source to AM/PULSE MOD INPUT connector.

NOTE

Voltages required for external control of the RF carrier are +15 volts dc for full-on operation and -15 volts dc for full-off operation.

22. Adjust Attenuator Control and dc control voltage input for desired RF output level.

Figure 3-3. Controls, Indicators and Connectors Used in Operation with Externally Supplied Signals (Cont.)

Figure 3-4. Controls, Indicators, and Connectors Used in Phase-Lock Operation (Model 608F Only)

NOTE

Perform turn-on procedures listed in paragraph 3-9, and prepare the Model 8708A Synchronizer for use with the Model 608F using procedures contained in Section III of the Operating and Service Manual for Synchronizer 8708A.

1. Align cursor knob with panel marker.
2. Align FINE FREQ control with panel marker.
3. Set FREQUENCY RANGE switch to desired range (frequency limits for each range shown on MEGACYCLES dial housing).
4. Set MODULATION switch to the CW position.

CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the Signal Generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inoperative while the equipment is connected to the signal generator (refer to NOTE in paragraph 3-7).

5. Connect the equipment under test to the RF OUTPUT connector observing that the signal generator is terminated in the proper load (refer to paragraph 3-8).

NOTE

If deemed necessary, conduct power output calibration procedures for the selected frequency range as listed in procedural steps d. through h. in paragraph 3-15.

6. Tune the Frequency Control until MEGACYCLES dial cursor is aligned with frequency to be used as indicated on the dial face.

NOTE

To crystal calibrate the frequency, refer to procedures listed in paragraph 3-13.

7. Depress and tune AMPL TRIMMER control for maximum indication on RF OUTPUT meter.
8. Adjust RF OUTPUT control until RF OUTPUT meter pointer is aligned with +7 dBm mark (ATTENUATOR CALIBRATED).

NOTE

Accuracy of the Attenuator Control setting and PERCENT MODULATION meter are within specifications only when the RF OUTPUT meter is indicating ATTENUATOR CALIBRATED.

9. Adjust Attenuator Control for desired output level.
10. Connect coaxial cable between UNCAL RF OUTPUT connector on the Model 608F and the RF INPUT connector (beneath lighted lamp) on the Model 8708A Synchronizer.
11. Connect coaxial cable between FREQ ANALOG OUTPUT connector on the Model 608F and the FREQ ANALOG INPUT connector on the Model 8708A Synchronizer.
12. Connect coaxial cable between FREQ CONTROL INPUT connector on the Model 608F and the FREQ CONTROL OUTPUT connector on the Model 8708A Synchronizer.

NOTE

With the foregoing adjustments and connections completed phase-lock operation of the Model 608F can begin. Frequency or phase modulation of the RF carrier can be accomplished using the procedures listed in Figure 3-2 of the 8708A Manual.

Figure 3-4. Controls, Indicators, and Connectors used in Phase-Lock Operation (Model 608F Only)(Cont.)

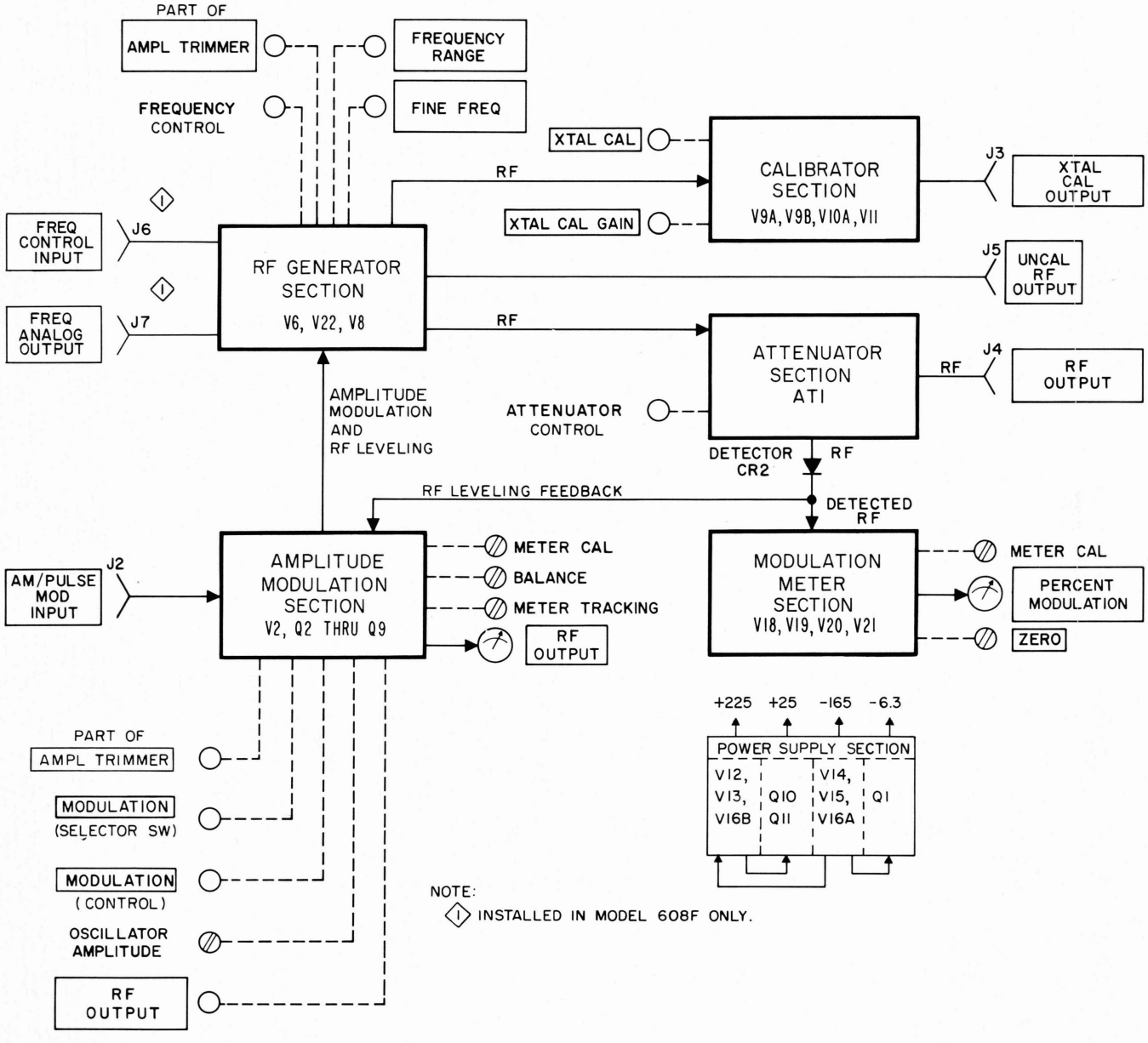


Figure 4-1. Overall Block Diagram, Models 608E and 608F

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains principles of operation for the Model 608E and Model 608F Signal Generators. Included herein is a general description of the instruments to a block diagram level, and a detailed circuit description which references the schematic diagrams. Principal dissimilarities between the Model 608E and 608F occur in the RF Generator Section; therefore, this section of each instrument will be described separately. The remaining sections in both instruments are nearly identical. These sections will be presented in a single description with the minor differences between instruments noted.

4-3. GENERAL DESCRIPTION.

4-4. As illustrated in Figure 4-1, the signal generators contain a RF Generator Section, Amplitude Modulation Section, Attenuator Section, Calibrator Section, Modulation Meter Section, and Power Supply Section. Each section is described in the succeeding paragraphs.

4-5. RF GENERATOR SECTION, MODEL 608E.

4-6. The RF Generator Section in the Model 608E includes RF Oscillator V6, Buffer Amplifier V22, Power Amplifier V8, and associated circuitry. The RF Oscillator generates sine-wave signals from 10 MHz to 480 MHz in five frequency bands, which are identified in Figure 3-1 (item 8). Operation of the FREQUENCY RANGE switch selects tuned circuits in both the RF Oscillator and Power Amplifier stages for the desired operating range, and the Frequency Control adjustment selects frequencies within the range. The latter control tunes the RF Oscillator and Power Amplifier simultaneously. Minor frequency adjustments can be made by use of the FINE FREQ control connected in the output circuit of RF Oscillator V8. An uncalibrated RF output signal is also provided at the output circuit of Oscillator V6. The signal is applied to UNCAL RF OUTPUT connector J5 and is available for use with a frequency counter or other external measuring equipment. Buffer Amplifier V22 isolates RF Oscillator V6 and the output stages. A connection between the output stage of Buffer Amplifier V22 and the input circuit of Power Amplifier V8 serves as the modulation point, with the modulating signal being received from the Amplitude Modulation Section. The modulated RF signal is amplified in V8 and applied to the output circuit of the stage, which has been tuned by the FREQUENCY RANGE and Frequency Control adjustments. The AMPL TRIMMER control connected in the output circuit of Power Amplifier V8 is mechanically linked to a pushbutton switch in the Amplitude Modulation section. The interconnected control permits peaking the RF output of the instrument, and maintaining a fixed RF output across the frequency range of the instrument. Tuning the control without engaging the pushbutton provides a fine-tune adjustment, which is used in conjunction with the RF OUTPUT control to maintain a fixed, leveled RF output regardless of the selected frequency. Depressing the control and then tuning permits a sharp peak to be obtained on the RF OUTPUT meter for optimizing the RF output of Power Amplifier V8.

4-7. RF GENERATOR SECTION, MODEL 608F.

4-8. The RF Generator Section in the Model 608F Signal Generator is essentially the same as the Model 608E, containing the RF Oscillator, Buffer Amplifier, and Power Amplifier stages discussed in paragraph 4-5. Frequency capability of the instrument is between 10 MHz and 455 MHz in five frequency ranges. Differences between the frequency capabilities of the Model 608F and 608E can be ascertained by reference to Figure 3-1 (item 8). Two circuits and associated input and output connectors have been added to the Model 608F to permit the unit to be used with a Model 8708A Synchronizer. This equipment arrangement provides a highly stable, phase-locked RF signal output from the Model 608F, or permits the instrument to be used in narrow-band frequency or phase modulation applications. During use with a synchronizer a connection is made between UNCAL RF OUTPUT connector J5 on the Model 608F and synchronizer to provide a sample to the uncalibrated RF signal output from RF Oscillator V6. A second connection is made between the synchronizer and FREQ CONTROL INPUT connector J6 on the Model 608F. The latter connection delivers dc control voltage to varactors connected across the tank circuit of RF Oscillator V6 in the Model 608F. This dc control voltage reflects any frequency difference between the uncalibrated RF signal output of V6 and a calibrated reference frequency developed in the synchronizer. Hence, any drift in the output of RF Oscillator V6 is detected and an offsetting control voltage is returned to the Model 608F to maintain a correct frequency output. A third connection between the Model 608F and synchronizer is made at FREQ ANALOG OUTPUT connector J7. This connection provides a resistance to the synchronizer that is inversely proportional to the frequency in use. The resistance is used to maintain constant loop gain across the frequency band during phase-lock operation.

4-9. AMPLITUDE MODULATION SECTION.

4-10. The Amplitude Modulation Section consists of Modulation Oscillator V2, Differential Amplifier Q2 and Q3, Sine-Wave Amplifier Q4, Pulse Amplifier Q5, Amplifiers Q6 and Q7, Modulators Q8 and Q9, the RF OUTPUT meter, and associated circuits. Selection of

the signal generator mode of operation is made by use of the MODULATION selector switch connected in the Amplitude Modulation Section. The four modes of operation are internal sine-wave modulation (400 or 1000 Hz), external sine-wave modulation, external pulse modulation, and cw operation; these four operations are discussed in the following paragraphs.

4-11. INTERNAL SINE-WAVE MODULATION. To select internal modulation, the MODULATION selector switch is set to either the 400 ~ or 1000 ~ position. Modulation Oscillator V2 provides a sine-wave output of fixed amplitude established by the Oscillator Amplitude control, a screwdriver adjustment within the instrument. The sine-wave output is then applied to transistor Q3 in the differential amplifier stage, and to AM/PULSE MOD INPUT connector J2. The signal at the connector is made available for synchronizing external equipment during internal modulation operation. The second signal applied to Differential Amplifier Q2-Q3 is a detected RF output signal received from diode CR2. This leveling feedback signal, which is used to counteract variations in the RF output signal, is applied to transistor Q2. The product of Differential Amplifier Q2-Q3 is amplified in Sine-Wave Amplifier Q4, and Amplifiers Q6 and Q7, then passed to Modulators Q8 and Q9. During internal and external modulation and when CW operation is conducted, Pulse Amplifier Q5 is disabled. Signal output from the modulator stage is applied to the input circuit of Power Amplifier V8 in the RF Generator Section where modulation of the RF signal and signal leveling occur. A MODULATION control between Modulator Oscillator V2 and transistor Q3 in the differential amplifier stage provides an adjustment to select the desired percentage of modulation as observed on the PERCENT MODULATION meter discussed in paragraph 4-19. The RF OUTPUT control connected in the differential amplifier stage is used in conjunction with the Attenuator Control to calibrate RF power output from the instrument. Final selection of the desired output level up to +7 dBm is made using the Attenuator Control in both the Model 608E and 608F. In the Model 608E only, an RF output level above +7 dBm is selected by use of the RF OUTPUT control only. The AMPL TRIMMER control in the Amplitude Modulation Section is ganged to a tuning control in the output circuit of Power Amplifier V8 in the RF Generator Section. Operation of these controls is discussed in paragraph 4-5. The Meter Cal, Balance, and Meter Tracking controls are internal adjustments to set the RF OUTPUT meter and differential amplifier stage for proper operation.

4-12. EXTERNAL SINE-WAVE MODULATION. During external sine-wave modulation a connection is made between the external modulating equipment and AM/PULSE MODE INPUT connector J2 on the instrument, and the MODULATION selector switch is set to the AM position. The latter adjustment disables Modulation Oscillator V2, and routes the incoming modulation signal through the MODULATION control to transistor Q3 in the differential amplifier stage. Operation of the remaining circuits and controls in the Amplitude Modulation Section is identical to that described in paragraph 4-11.

4-13. EXTERNAL PULSE MODULATION. To set the signal generators for external pulse modulation, the desired RF output level and operating characteristics of the Amplitude Modulation Section are established with the MODULATION selector switch in the PULSE/SET RF OUTPUT position. The switch position enables Pulse Amplifier Q5 and disables Modulation Oscillator V2 and Sine-Wave Amplifier Q4. With the MODULATION switch in the PULSE/SET RF OUTPUT position, the operating characteristics of Amplifier Q7 and Modulators Q8-Q9 in the Amplitude Modulation Section are established by use of the RF OUTPUT control, and the desired RF output level from the instruments selected as observed on the RF OUTPUT meter. Fine adjustment of the RF output level can be made at this time using the AMPL TRIMMER and RF OUTPUT controls conjunctively. Upon completion of these preliminary adjustments, the MODULATION selector switch is set to the PULSE position, and the external pulse source connected to the signal generators at AM/PULSE INPUT connector J2. The input signals are amplified by transistors Q5, Q6 and Q7 then passed to Modulators Q8-Q9. The output of the Modulator stage is applied to the input circuit of Power Amplifier V8 where modulation of the RF signal occurs. During pulse modulation, the MODULATION, RF OUTPUT and AMPL TRIMMER controls should not be operated after initial adjustments are made, and the PERCENT MODULATION and RF OUTPUT meters are inoperative. To readjust the RF output level, the external modulating source must be removed at connector J2, and the MODULATION switch returned to the PULSE/SET RF OUTPUT position. Adjustment of the RF OUTPUT and AMPL TRIMMER controls can then be made as previously discussed.

4-14. CW OPERATION. When the instrument is set for CW operation with the MODULATION selector switch in the CW position, Modulation Oscillator V2 and transistor Q3 in the differential amplifier stage are disabled. The RF leveling signal received from diode CR2 is passed through the Amplitude Modulation Section in a normal manner, and applied to the input circuit of Power Amplifier V8 in the RF Generator Section for stabilization of the RF power output level. The RF leveling signal is also applied to the RF OUTPUT meter circuit in the Amplitude Modulation Section for RF level calibration. Operation of both the AMPL TRIMMER PUSH TO PEAK and RF OUTPUT controls is identical to that described in paragraph 4-11.

4-15. ATTENUATOR SECTION.

4-16. Attenuator Section AT1 couples RF energy from Power Amplifier V8 in the RF Generator Section to the load through RF OUTPUT connector J4, and provides control over the RF output level. The previously discussed RF leveling signal developed across diode CR2 is provided by a second RF output from the Attenuator Section. The Attenuator Control is used in conjunction with the RF OUTPUT meter and RF OUTPUT control in the Amplitude Modulation Section to calibrate the RF output level of the instrument, and also to select the desired output level from the equipment after calibration procedures have been completed.

4-17. CALIBRATOR SECTION.

4-18. The Calibrator Section consists of 5-MHz Oscillator V9A, 1-MHz Oscillator V9B, Amplifiers V10A and V11, and the associated circuits. Operation of the oscillators is controlled by the XTAL CAL toggle switch that has three positions; OFF, 1 MC, and 5 MC. With the selector switch in either the 1 MC or 5 MC position, an output from the active oscillator is mixed with a sample RF signal from Power Amplifier V8 in the RF Generator Section to produce audio beat signals. The audio signals are passed through amplifiers V10A and V11 to a matching transformer. The transformer output is then applied to XTAL CAL OUTPUT connector J3 for use by an operator during frequency calibration operations. A XTAL CAL GAIN control connected in the output circuit of Amplifier V11 provides an audio output level adjustment.

4-19. MODULATION METER SECTION.

4-20. The Modulation Meter Section consists of stabilized wideband amplifiers V18 and V19, rectifier V20, and twin-triode V21 connected in a bridge circuit. Prior to operation the PERCENT MODULATION meter, also connected in the bridge circuit, is calibrated by use of the Meter Calibration control, an internal adjustment. Also, the bridge circuit is balanced to electrical zero by the ZERO adjustment located on the front panel of the instrument. The RF signal output of the Attenuator Section is detected across diode CR2 and applied to a filter network that produces the modulating signal. This signal is amplified in V18 and V19, rectified in V20, and applied to the bridge circuit. The bridge circuit is unbalanced in direct proportion to the peak amplitude of the input modulating signal; therefore, the PERCENT MODULATION meter connected across the bridge indicates the degree of unbalance in the bridge, or the percentage of modulation. The percentage of modulation is established by use of the MODULATION control in the Amplitude Modulation Section.

4-21. POWER SUPPLY SECTION.

4-22. The Power Supply Section consists of four series-regulated interrelated power supplies. The +225-volt power supply contains Comparison Amplifier V12 and a Series Regulator comprised of both sections of V13 and V16B. The +25-volt power supply contains Reference Amplifier Q10 and Series Regulator Q11. The -165 -volt power supply consists of Reference Tube V15, Comparison Amplifier V14, and Series Regulator V16A. The -6.3 volt supply contains a reference diode and Series Regulator Q1. The -165 volt supply is used to reference both the -6.3 volt and +225 volt supplies. The +225 volt supply is used to reference the +25 volt supply. A further discussion of these power supplies is contained in the detailed circuit description that follows.

4-23. DETAILED DESCRIPTION.

4-24. This discussion describes the circuits in the RF Generator Section (Model 608E), RF Generator Section (Model 608F), Amplitude Modulation Section, Attenuator Section, Calibrator Section, Modulation Meter Section, and the Power Supply Section. Figures 7-4 and 7-5 will be used as reference during the description, and where transition from one diagram to the second is required appropriate notice will be made.

4-25. RF GENERATOR SECTION, MODEL 608E.

4-26. The RF Generator Section in the Model 608E includes RF Oscillator V6, Buffer Amplifier V22, and Power Amplifier V8. RF Oscillator V6 is a type 4042 triode connected across the +225 and -165 Vdc supplies in a Colpitts circuit. The oscillator tank circuit contains split-stator capacitor C17A and five separate RF transformers mounted on a revolving turret assembly. Capacitor segment C17A is mechanically linked to segment C17B in the output circuit of Power Amplifier V8, and the oscillator turret assembly is linked to an amplifier turret assembly also located in the output circuit of V8. Choice of frequency band is made by operating the FREQUENCY RANGE switch located on the front panel of the instrument. This function rotates the oscillator and power amplifier turret assemblies simultaneously to the selected range (Range A through E), and sets the associated inductor (L1 through L6, and L12 through L16) into the output circuits of RF Oscillator V6 and Power Amplifier V8 respectively. Capacitors C17A and C17B are then tuned by the front-panel mounted Frequency Control to the desired frequency within the range. Minor frequency adjustments can be made by tuning capacitor C68 (FINE FREQ control) in the tank circuit of Oscillator V6.

4-27. The plate circuit of RF Oscillator V6 is series fed through resistors R246 and R247. These resistors in conjunction with resistor R43 in the cathode of the stage serve to limit plate current within safe limits. The cathode of Oscillator V6 is bypassed by capacitor C25, which is part of the tube mounting plate and is not visible when the plate is in position. Bias for the stage is developed by cathode resistor R249 and grid resistor R248, with coupling capacitor C16 returning feedback to the grid to maintain oscillation. Capacitor C59 connected across a portion of the tuned circuit is used to calibrate the high end of the frequency dial after replacing an oscillator tube. Capacitor C18, installed in the Model 608E only, is used to improve tracking characteristics of the tuned circuit at higher frequencies. Adjustment of this internal control is critical, since a compromise must be reached between tracking capabilities and optimum power output. Misadjustment of capacitor C18 can produce improved tracking capability but a loss in RF power output. The control is factory aligned, and no further adjustment should be required.

4-28. All voltages applied to RF Oscillator V6 located in the RF Generator housing assembly are regulated, and brought into the stage through RFI filters. The +225 Vdc plate voltage is received through filter FL5, the -165 Vdc supply is received through filter FL2, and a regulated -6.3 heater voltage is received through filter FL4.

4-29. The secondary windings in the oscillator turret assembly couple RF energy from RF Oscillator V6 through a coaxial cable to Buffer Amplifier V22. Resistors R240, R242, R244, and R245 located in the secondary windings of coils L2 through L5 damp undesirable resonance in the cathode of Buffer Amplifier V22. Resistors R241 and R243 connected across the secondary windings of coils L4 and L5 limit the RF drive at lower frequencies. Resistors R250, R251, and capacitor C218 form a take-off network for an uncalibrated RF output signal that is applied through coaxial cable W1 to UNCAL RF OUTPUT connector J5. Resistor R251 in the take-off network is 301 ohms in the Model 608E and 200 ohms in the Model 608F. This configuration is due to the difference in RF output level between instruments. The RF signal at connector J5 can be used with a frequency counter or other external measuring equipment. When the Model 608F is used with a Model 8708A synchronizer during phase-lock operation, the signal is used by the synchronizer.

4-30. Buffer Amplifier V22 is a type EC-8010 triode connected as a grounded-grid amplifier. The stage isolates RF Oscillator V6 and Power Amplifier V8, and reduces any incidental frequency modulation to a minimum level. Cathode resistors R255 and R252 operate with resistors R254 and R256 in the plate circuit to limit plate current to a safe value. Power to the stage is supplied through RFI filters FL2, FL4, and FL5, with the plate, cathode and filament supplies being decoupled by capacitors C222, C220, and C221 respectively. The plate circuit of Buffer Amplifier V22 is coupled to the cathode circuit of Power Amplifier V8 through a wide-band network consisting of dc blocking capacitor C224 and coil L22. Coil L20 in the plate circuit of V22 serves as an RF choke, while isolation network L11 blocks an RF signal path to the output circuit of the Amplitude Modulation Section.

4-31. Power Amplifier V8 is a grounded-grid, cathode-modulated amplifier that delivers the modulated or CW output signal to the Attenuator Section. The plate circuit of V8 contains the amplifier turret assembly which houses inductors L12 through L16. These inductors are placed into the output circuit of V8 by operation of the FREQUENCY RANGE switch discussed in paragraph 4-26. The second segment of Frequency Control capacitor C17 is also located in the plate circuit of Power Amplifier V8. Linkage between capacitor C17B and C17A in the RF Oscillator Stage permit tuning to a frequency within a range as discussed in paragraph 4-26. A second linkage between capacitor C17B and the AMPL TRIMMER control permit the capacitor to be tuned separately or in conjunction with push-to-operate switch S6 in the Amplitude Modulation Section for peaking the RF output signal. This function is discussed further in paragraph 4-45.

4-32. When the instrument is set to provide an amplitude modulated output, the modulating signal and an RF leveling signal are received at the cathode of Power Amplifier V8 from the Amplitude Modulation Section through isolation network L11. During CW operation, only the RF leveling signal is received from the Amplitude Modulation Section. Diode CR7 connected in the signal path prevents damage to Power Amplifier V8 by limiting the negative swing of the cathode. Capacitor C32 is connected in the plate circuit of V8 in the Model 608F only, and is adjusted for improved tracking characteristics in the power amplifier stage at higher frequencies. Capacitors C30, C229, C230, and C231 connected across coils L16, L15, L14, and L13 respectively are also installed in the Model 608F only. These capacitors are selected in test to improve tracking between the power amplifier and oscillator stages. Nominal values for the capacitors are illustrated in Figure 7-4. The RF output signal from Power Amplifier V8 is inductively coupled through the amplifier turret assembly coil and applied to the Attenuator Section. This section of the instrument is discussed in paragraph 4-51.

4-33. RF GENERATOR SECTION, MODEL 608F.

4-34. The RF Generator Section in the Model 608F is essentially the same as the generator section in the Model 608E, except for the addition of circuits to permit the unit to be used with a Model 8708A Synchronizer. These circuit differences occur in the tank circuit of RF Oscillator V6 and the output stage of Power Amplifier V8.

4-35. Two varactor diodes, CR31 and CR32, are connected across the oscillator tank circuit in the Model 608F. The varactors are reverse-biased junctions that act as variable capacitors, changing capacitance with a change in the applied reverse bias. In quiescent condition the diodes are biased by a voltage divider network comprised of resistors R271, R267, and R268. A change in bias, and the resultant change in capacitance, is produced by a dc control voltage received at FREQ CONTROL INPUT connector J6. During operation with a Model 8708A Synchronizer, a connection is made between UNCAL RF OUTPUT connector J5 and the synchronizer to provide a sample of the RF output from the Model 608F. A second connection is made between the synchronizer and FREQ CONTROL INPUT connector J6 to receive the dc control voltage from the synchronizer. The frequency sample sent to the synchronizer is compared to a reference frequency developed in the synchronizer. A drift tendency in RF Oscillator V6 is compared with the reference frequency, and translated into a dc control voltage for application to varactors CR31 and CR32 in the Model 608F. The varactors change capacitance in direct proportion to the detected drift holding RF Oscillator V6 on frequency.

4-36. Potentiometer R269 is installed in the Model 608F only, and is mechanically linked to Frequency Control capacitor C17B in the output circuit of Power Amplifier V8. The potentiometer output resistance varies as the Frequency Control adjustment is tuned, presenting 4K ohms at the low-frequency end of the capacitor tuning range and zero ohms at the high-frequency end. The resistance is applied through FREQ ANALOG OUTPUT connector J7 to the dc control voltage circuit in the synchronizer. This loop arrangement controls the voltage level applied to varactors CR31 and CR32, thereby assuring correct

operating conditions for the devices across a frequency range.

4-37. AMPLITUDE MODULATION SECTION.

4-38. The Amplitude Modulation Section consists of Modulation Oscillator V2, a portion of the Modulator and ALC Board, a RF OUTPUT meter and control, two MODULATION controls, and the associated circuitry. The Modulator and ALC Board contains Differential Amplifier Q2-Q3, Sine-Wave Amplifier Q4, Pulse Amplifier Q5, Amplifiers Q6 and Q7, and Modulators Q8 and Q9. Four modes of operation will be discussed during the description of the Amplitude Modulation Section; these are identified as internal sine-wave modulation, external sine-wave modulation, external pulse modulation, and CW operation.

4-39. INTERNAL SINE-WAVE MODULATION. The internal sine-wave modulation mode is selected by placing MODULATION switch S7 to either the 400 ~ or 1000 ~ position (switch setting 2 or 3), which provides a 400 $\pm$ 40 Hz or a 1000 $\pm$ 100 Hz output from Modulation Oscillator V2. The oscillator consists of resistance-coupled amplifiers V2A and V2B connected in a Wein-Bridge circuit. At the resonant frequency, positive feedback from the plate of Amplifier V2B is applied to the grid of amplifier V2A sustaining oscillation. A change in frequency is obtained by inserting resistors R3-R5 or R4-R6 into the feedback network through two segments of MODULATION switch-wafer 2F. A negative feedback circuit consisting of resistors R7, R8 and lamp DS1 is used to stabilize the oscillator, reduce distortion, and maintain a constant output level. If the amplitude of the signal increases, current through the lamp increases thereby raising the resistance of lamp DS1; consequently, the signal amplitude is held constant. Potentiometer R7 is an internal adjustment for adjusting the amplitude of the output signal. Heater voltage to the stage is applied at all times during instrument operation; however, plate voltage is applied to V2A and V2B only when MODULATION switch-wafer 2R is in position 2 or 3.

4-40. The sine-wave signal from Modulation Oscillator V2 is applied through dc blocking capacitor C205, MODULATION switch-wafer 1F, to MODULATION control R210. A second signal path for the sine-wave is provided through resistor R262 to AM/PULSE MOD INPUT connector J2 where the signal is available for synchronizing external equipment during the internal modulation mode. The signal at the wiper of MODULATION control R210 is passed through, a frequency-compensation network consisting of resistor R261, and capacitors C203 and C204. The signal is then routed through MODULATION switch-wafer 1R to the base of transistor Q3 in the differential amplifier stage. The second input to the differential amplifier is a detected signal developed across diode CR2 and filter network C38 and R119 located in the bolometer portion of the Attenuator Section. This leveling signal, which is representative of the RF power output from the instrument, is passed through RFI filter FL8 to the base of transistor Q2. The leveling signal is also applied through resistor R201, Meter Cal potentiometer R202. MODULATION switch-wafer 4F, and AMPL TRIMMER pushbutton switch S6 to RF OUTPUT meter M1. Operating characteristics of switch S6 and the RF OUTPUT meter are contained in paragraph 4-45.

4-41. Balance potentiometer R203 is a board adjustment in the emitter circuit of Differential Amplifier Q2 and Q3 used to set the stage for proper operation. The RF OUTPUT control R212 connected with resistor R213 in a voltage divider network sets the operating characteristics of the differential amplifier stage, and is used in conjunction with the Attenuator Control to calibrate and control the RF output from the instrument. The output of the differential amplifier is the product of the leveling signal on the base of transistor Q2 and the modulating signal on the base of transistor Q3. This product signal is then applied to the base of Sine-Wave Amplifier Q4.

4-42. The base circuit of amplifier Q4 contains a low-frequency compensating network consisting of resistor R214 and capacitor C202. In the Model 608E resistor R214 is 200 ohms, and in the Model 608F the resistor value is 392 ohms. Amplifier Q4 is biased by voltage divider network R217 and R215, with diode CR21 installed as a protective device to maintain a safe relationship between the base and emitter circuits of Q4 during operation. The collector circuit of Q4 also contains two frequency-compensating networks consisting of resistor R219 and capacitor C208, and resistor R218 and capacitor C207. The output of amplifier Q4 is developed across resistor R216 and applied to the base circuit of Amplifier Q6.

4-43. During internal or external sine-wave modulation, Amplifier Q6 receives the leveling and modulating signals from Amplifier Q4. During CW operation, only the leveling signal is received at Amplifiers Q4 and Q6. During external pulse modulation, Amplifier Q4 is inhibited and the input pulse signals are received at Amplifier Q6 from Pulse Amplifier Q5. The external pulse modulation and CW modes of operation are discussed later in this section. The emitter of Amplifier Q6 is biased by a voltage divider network consisting of resistors R223 and R224, and during internal sine-wave operation the modulating and leveling signals are developed across load resistor R222 for application to Amplifier Q7.

4-44. Resistor R229 and capacitor C211 provide emitter bias for Amplifier Q7, while the collector voltage is developed across load resistor R228 and resistor R233. This voltage divider network also establishes the base conditions on Modulators Q8 and Q9. During the pulse modulation mode, the collector voltage on Amplifier Q7 can be controlled by operation of the RF OUTPUT control; this function is discussed in paragraph 4-47. The collector output of Amplifier Q7 is applied to the base of Modulators Q8 and Q9 connected in parallel emitter-follower configuration. The emitter bias for the stage is derived from a voltage divider network consisting of resistor R33, Zener diode CR26, and resistor R258 in the RF Generator Section. Diode CR25 is connected as a protective device between the base and emitter circuits of the stage. The modulator

output is applied through RFI filter FL6 and isolation network L11 to the cathode of Power Amplifier V8, where modulation and RF leveling occur.

4-45. A feedback path for the output of Modulators Q8 and Q9 is provided through filter network R235 and capacitor C200 which removes the modulating signal. The leveling signal is passed through MODULATION switch-wafer 4F and applied to the normally-open contacts of AMPL TRIMMER pushbutton switch S6 when the MODULATION switch is in positions 1 through 4. As previously mentioned, the AMPL TRIMMER pushbutton is mechanically linked to AMPL TRIMMER capacitor C17B in the output circuit of Power Amplifier V8. During normal operation the detected feedback from diode CR2 in the Attenuator Section is applied through resistor R201, potentiometer R202, and the normally-closed contacts of pushbutton switch S6 to RF OUTPUT meter M1; therefore, the meter normally displays the leveled RF output of the instrument. Rotation of RF OUTPUT control R212 changes the conduction level of Differential Amplifier Q2-Q3 and the signal output level of Modulators Q8-Q9. This change is reflected in the RF output of Power Amplifier V8, and displayed on RF OUTPUT meter M1. Operation of AMPL TRIMMER control C17B without engaging the pushbutton provides a fine-tune adjustment for use with the RF OUTPUT control to maintain a constant, leveled RF output across a frequency range. When AMPL TRIMMER pushbutton S6 is depressed the leveling signal feedback from Modulators Q8-Q9 is displayed on meter M1, and operation of the control permits a sharp peak to be observed on the meter. Hence, the RF output of Power Amplifier V8 can be peaked. During internal and external sine-wave operation, MODULATION control R210 controls the level of the modulation and is used in conjunction with the PERCENT MODULATION meter discussed in paragraph 4-59.

4-46. EXTERNAL SINE-WAVE MODULATION. Operation of the instruments during external sine-wave modulation is similar to the internal mode, and is established by setting MODULATION switch S7 to the AM position (switch position 4). Modulation Oscillator V2 is disabled by removing the stage plate voltage at MODULATION switch-wafer 2R, and a signal path of the external sine-wave signal is established through MODULATION switch-wafer 1F. A cable connection is made between the external source and AM/PULSE MOD INPUT connector J2, with the incoming signal being routed to MODULATION control resistor R210. The signal is then applied through the frequency-compensation network and MODULATION switch-wafer 1R to the base of transistor Q3 in the differential amplifier stage. Operation of the remaining circuits and controls in the Amplitude Modulation Section is the same as described during internal sine-wave modulation.

4-47. EXTERNAL PULSE MODULATION. During this mode of operation MODULATION switch S7 is set first to the PULSE/SET RF OUTPUT position (switch position 5) to establish operating conditions in the output circuit of the Amplitude Modulation Section, and consequently the RF output level of the instrument. The switch is then set to the PULSE position (switch position 6) to pulse modulate the RF carrier. In both positions Modulation Oscillator V2 is disabled and the input signal path through MODULATION control resistor R210 is interrupted. The position of MODULATION switch-wafer 4F interrupts the leveling signal path through the normally-open contacts of AMPL TRIMMER pushbutton switch S6, and removes the push-to-peak function of the AMPL TRIMMER control during pulse operation. However, the detected signal from diode CR2 in the Attenuator Section is received through resistor R201 and potentiometer R202 for application to RF OUTPUT meter M1. Therefore, in the PULSE/SET RF OUTPUT position, the AMPL TRIMMER and RF OUTPUT controls can be used to set the desired RF output level as indicated on the RF OUTPUT meter. The two controls are operated only in the PULSE/SET RF OUTPUT position.

4-48. Transistor Q3 in the differential amplifier stage has an inhibiting voltage applied to the base through resistor R211 and MODULATION switch-wafer 1R. With transistor Q3 cut off, transistor Q2 conducts heavily and places a disabling voltage on the base of Amplifier Q4. This condition interrupts to leveling signal path through the Amplitude Modulation Section. Resistor R212 is removed from the circuit by the position of MODULATION switch-wafer 1R; however, the RF OUTPUT control is also connected to potentiometer R226 in the collector circuit of Amplifier Q7 for rf output level control. With the MODULATION switch in position 5, a positive voltage is applied to the base of Pulse Amplifier Q5 through resistors R220 and R225 to enable the amplifier. The position of MODULATION switch-wafer 3R forms a voltage divider network consisting of resistors R228, R226, and R270 in the collector circuit of Amplifier Q7 and the base circuits of Modulators Q8 and Q9. Operation of RF OUTPUT potentiometer R226 controls the conduction level of transistors Q7, Q8, and Q9, and the output level of Power Amplifier V8.

4-49. While the MODULATION switch is still in the PULSE/SET RF OUTPUT position, the RF OUTPUT control is adjusted for an indication on RF OUTPUT meter M1. AMPL TRIMMER control C17B in the output stage of Power Amplifier V8 is then peaked for maximum RF output. The RF OUTPUT is readjusted for an indication of +7 dBm (Attenuator Calibrated) on RF OUTPUT meter M1. With the preliminary adjustments completed, the external modulating equipment is connected to AM/PULSE MOD INPUT connector J2, and MODULATION switch S7 is set to the PULSE position (switch position 6). The incoming pulse train is passed through MODULATION switch-wafer 3F to the base of Pulse Amplifier Q5, and then routed through Amplifier Q6 and the remaining circuits of the Amplitude Modulation Section as previously described.

4-50. CW OPERATION. To set the equipment for CW operation, MODULATION switch S7 is placed to the CW position (switch position 1). Modulation Oscillator

V2 is removed from the circuit by the position of switch-wafer 2R, and the sine-wave input circuit is interrupted by the setting of switch-wafer 1F. A detected RF output signal from diode CR2 in the Attenuator Section is applied to the base of transistor Q2 in the differential amplifier stage for the development of a leveling signal as previously described. RF OUTPUT meter M1 also receives the detected signal through AMPL TRIMMER pushbutton switch S6. Transistor Q3 in the differential amplifier stage is terminated in a network consisting of resistor R263 and capacitor C206; however, RF OUTPUT control resistor R212 is connected in the circuit and controls conduction of the differential amplifier stage. Pulse Amplifier Q5 is disabled by the ground applied to the base circuit through MODULATION switch-wafer 3F. Leveling signal output of the differential amplifier stage is passed through Amplifiers Q4, Q6, Q7 and Modulators Q8-Q9 to the input circuit of Power Amplifier V8. RF OUTPUT meter M1 displays a leveled RF output from the instrument as selected by the RF OUTPUT control and Attenuator Control. AMPL TRIMMER pushbutton switch S6 is returned to operation in conjunction with AMPL TRIMMER capacitor C17B for peaking the RF output using the leveling signal feedback from Modulators Q8-Q9.

4-51. ATTENUATOR SECTION.

4-52. To extract power from the RF Generator Section, a piston-type attenuator is used. The attenuator housing projects through the rear of the generator housing, and provides an open-ended termination near the power amplifier plate-circuit inductor. A single-turn pick-up loop at the end of the attenuator probe couples energy to an impedance-matching network consisting of capacitors C69 and C37, and resistors R58 and R59. Capacitor C37 is a movable slug in the probe body that is used to adjust the standing-wave ratio to a minimum value when RF OUTPUT connector J4 is terminated in a 50-ohm load.

4-53. The front-panel mounted Attenuator Control moves the probe in the attenuator housing, and controls the amount of RF energy passed to the output connector. In both the Model 608E and 608F, calibration is accomplished by adjusting the RF OUTPUT and AMPL TRIMMER controls for a steady +7 dBm (ATTENUATOR CALIBRATED) indication on the RF OUTPUT meter across the frequency range in use. An adjustment of the Attenuator Control after calibration procedures are completed provides the RF output level indicated on the control dial as long as the RF OUTPUT meter needle remains in the ATTENUATOR CALIBRATED position. In the Model 608E only, an rf output between +7 dBm and +13 dBm can be selected. The Attenuator Control is set to the +7 dBm position (maximum clockwise), and the RF OUTPUT and AMPL TRIMMER controls are adjusted for the RF OUTPUT meter indication of +7 dBm as previously discussed. The desired output level above +7 dBm is then selected by operation of the RF OUTPUT control only, and the output is read directly from the RF OUTPUT meter.

4-54. Two parallel wires crossing the open end of the attenuator housing are used to provide a sample of RF energy delivered by Power Amplifier V8. The energy is applied to the Bolometer through ferrite-bead RFC1, which provides isolation between the Bolometer and Attenuator. The Bolometer contains frequency-response coil L17, diode CR2 and resistor R60. The RF signal detected across resistor R60 and diode CR2 is passed through an RF filter consisting of capacitor C38 and resistor R119. The detected signal is then applied through RFI filter FL8 to the Modulation Meter Section discussed in paragraph 4-60, and to transistor Q2 in the Amplitude Modulation Section discussed in paragraph 4-40.

4-55. CALIBRATOR SECTION.

4-56. The Calibrator Section consists of 5-MHz Oscillator V9A, 1-MHz Oscillator V9B, Harmonic Generator and Mixer CR1, Amplifiers V10A and V11, and output transformer T3. The oscillator and mixer circuits are illustrated in Figure 7-4, while the amplifiers and transformer are located on Figure 7-5.

4-57. The 5-MHz Oscillator is a crystal-controlled, electron-coupled oscillator utilizing the pentode half of a type 6U8 tube. The plate and screen circuits are tuned to the crystal frequency of 5 MHz by coils L6 and L7. Trimmer capacitor C23 is used for fine-frequency adjustment of the oscillator. The 1 MHz Oscillator consists of the triode portion of the tube, with coil L18 used to adjust the oscillator to a point where the fifth harmonic is synchronized with the 5-MHz output of Oscillator V9A. When XTAL CAL switch S4 is set to the 5-MC position, only Oscillator V9A is active. In the 1-MC position both oscillators are operating, with Oscillator V9A referencing the 1-MHz oscillator.

4-58. The output signal from Oscillators V9A or V9B is passed across dc blocking capacitor C24 to diode CR1 which acts as a harmonic generator and mixer. The anode of diode CR1 is inductively coupled to the output circuit of Power Amplifier V8 by running a lead near the plate of the amplifier. Oscillator harmonics within the diode are mixed with RF output signals to produce audio-beat frequencies across resistor R50 in the grid circuit of Amplifier V10A. The output of amplifier V10A is again amplified in V11 and applied across capacitor C36 to 600-ohm, line-matching transformer T3. The secondary of transformer T3 is connected to XTAL CAL OUTPUT connector J3 where the calibrating signals can be monitored. XTAL CAL GAIN resistor R56 provides front-panel control of the audio level output at connector J3.

4-59. MODULATION METER SECTION.

4-60. The Modulation Meter Section consists of a detector network in the Bolometer portion of the Attenuator Section, Amplifiers V18 and V19, Rectifier

V20, and a balanced-bridge circuit containing PERCENT MODULATION meter M2. The Bolometer is illustrated in Figure 7-4, and the remainder of the section appears in Figure 7-5.

4-61. The output of diode CR2, capacitor C38 and resistor R119 in the Bolometer is a dc signal which is representative of the RF output level, and the modulating signal when internal or external modulation is in process. The output is passed through RFI filter FL8 and applied to blocking capacitor C39, which couples the modulating signal to Amplifier V18. The output of Amplifier V18 is amplified again in V19 and passed to the plates of Rectifier V20. A stabilization feedback circuit connects the plate of Amplifier V19 and cathode of Amplifier V18, with resistor R99 and capacitor C55 installed in the circuit for frequency compensation.

4-62. Rectifier V20 is connected in a balanced-bridge detector circuit consisting of twin-triode V21, PERCENT MODULATION meter M2, and associated circuitry. With no modulating signal applied to the circuit, the steady-state dc potential at the plate of Amplifier V19 is coupled to the grids of V21A and V21B. In this condition, equal current flows on both sides of the bridge, and the PERCENT MODULATION meter reads zero. ZERO potentiometer R106 is a front-panel adjustment to compensate for variations in tube and component values. When a modulation mode of operation is in progress, the peak value of the rectified modulating signal is applied to the grid of V21B. The bridge is unbalanced accordingly, and produces an indication on the PERCENT MODULATION meter that is in direct proportion to the amplitude of the modulating signal. Triode V21A is unaffected during the detection cycle, since the modulating signal is filtered by resistors R100, R101, and capacitor C58.

4-63. POWER SUPPLY SECTION.

4-64. Four series-regulated power supplies are contained in the power supply section. The power supplies provide +225, -6.3, -165, and +25 volts dc to the Model 608 Signal Generators. The four supplies are connected to a common input source through ON switch S3. A slide switch located on the rear panel of the instrument sets the generators for use with either a 115-Vac or 230-Vac power source, with AC LINE fuse F1 connected between the power supplies and source as a protective device. The supplies are illustrated in Figure 7-5 and are described in the following paragraphs.

4-65. THE +225 VOLT SUPPLY. Input ac voltage to the +225-volt supply is received across transformer T1. The secondary contains bridge rectifier CR8 through CR11 and filter capacitor C40. The supply is series regulated through triodes V13A, V13B, and V16B, with the output connected to the load through front-panel mounted DC 0.25 AMP fuse F3. The -165 Volt Power Supply output is used as reference, being applied through a voltage divider consisting of resistors R70 through R72. Any change in the load is sensed across +225 Volts Adj potentiometer and applied to the control grid of Comparison Amplifier V12. The plate of amplifier V12 controls the conduction level of the series regulators, and holds the output voltage constant. The +225 volt supply is used to reference the +25 volt supply discussed in paragraph 4-69.

4-66. THE -6.3 VOLT SUPPLY. Input ac voltage to the -6.3-volt supply is also received across transformer T1. Rectification and filtering occur across bridge rectifier CR16 through CR19 and capacitors C75. Transistor Q1 operates as a comparison amplifier and series regulator, with the base circuit referenced by -7.5 Vdc developed from the -165 Vdc supply across resistor R260 and Zener diode CR20. The output voltage of 7.2 Vdc is applied to RFI Filter FL4 where 0.9 Vdc is dropped. The -6.3 volts is then used as a filament supply for RF Oscillator V6, Buffer Amplifier V22, and Power Amplifier V8. Filament voltage for the remaining tubes in the instrument is provided by a separate secondary winding of transformer T1. The latter winding also supplies voltage to a light behind the MEGACYCLES dial, and to the AC POWER light located on the front panel. Both lamps are lighted when switch S3 is in the ON position.

4-67. THE -165 VOLT SUPPLY. Input ac voltage to the -165 volt supply is received across transformer T1, and rectified by diodes CR12 through CR15. Triode V16A is the series regulator, with the grid controlled by the plate of Comparison Amplifier V14 whose cathode is referenced by gas tube V15. The voltage level is controlled -165 Volts Adj potentiometer R80, with the output applied to the load and to the +225 and -6.3 volt supplies for reference.

4-68. THE +25 VOLT SUPPLY. Components of the +25 volt supply are located on the Modulator and ALC Board, which also contains a portion of the Amplitude Modulation Section circuits discussed in paragraph 4-37. Ac power to the supply is received across transformer T2, and rectified by diodes CR29 and CR30. Transistor Q11 is the series regulator, with the conduction level being control by Amplifier Q10. The supply is referenced by +225 Vdc received across resistor R239.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains inspection requirements, performance and test procedures, troubleshooting techniques, and repair instructions for the Model 608E and 608F Signal Generators. Generally, maintenance procedures for both instruments are identical and will be presented in one set of instructions. Where differences occur, separate instructions for each instrument will be included. The test equipment required for maintenance is listed in Table 5-1. Test instruments other than those listed may be used if the performance equals or exceeds the minimum specification listed. Two test instruments must be fabricated; these include a 100-ohm termination and loop antenna, which are illustrated in Figure 5-1.

5-3. PERIODIC INSPECTION.

5-4. CLEANING.

5-5. If the equipment has been subjected to unusual conditions (excessive moisture, dust, heat, vibration, etc.) it is suggested that the instrument be removed from the cabinet and inspected for dirt or moisture accumulation, loosened components, or any possible sign of damage. Forced air under medium pressure is recommended for dusting and drying, although care must be taken not to vary the settings of the internal-adjustment potentiometers and capacitors during the process.

5-6. LUBRICATION.

5-7. The signal generators are thoroughly lubricated at the factory. Full-shielded ball bearings are used in many applications and require no subsequent attention. Ball bearings that are not fully shielded require only light machine oil. After prolonged use of the instrument, lubricated points should be checked for excessive dust accumulation or drying of lubricant.

5-8. The two worm gears used in the tuning-capacitor drive should be cleaned and lubricated approximately every sixty days. This maintenance is particularly important when the instrument is operated continuously or for several hours daily. Calibration accuracy and instrument dependability can be maintained only by proper lubrication of the two worm gears in the tuning mechanism. Other rubbing surfaces and sleeve bearings, including the small pulleys used in the attenuator drive system, should be lubricated quarterly with a light slideway oil such as Shell Tonna G. In all cases avoid over lubrication. The points to be lubricated are listed in Table 5-2 and illustrated in Figure 5-2.

5-9. PERFORMANCE TESTS.

5-10. PURPOSE.

5-11. The following paragraphs check performance of the signal generators during incoming inspection tests, periodic instrument evaluation, troubleshooting, and during equipment calibration periods. The tests can be performed without access to the interior of the instruments. The specifications listed in Table 1-1 are the performance standards. Unless otherwise specified in the test procedures, the following controls are set to the indicated position for each test:

MODULATION switch . . . . . CW

Cursor knob . . . . . Aligned with panel marker

FINE FREQ control . . Aligned with panel marker

XTAL CAL switch . . . . . OFF

5-12. FREQUENCY ACCURACY AND RESETTABILITY TEST.

a. Connect signal generator in test setup illustrated in Figure 5-3.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust FREQ OUTPUT and attenuator controls to obtain proper triggering of electronic counter.

d. Adjust frequency control to the low end, approximate center and high end of range A; record MEGACYCLES dial setting and electronic counter indication at each position. Electronic counter should indicate within $\pm 1\%$ of MEGACYCLES dial setting.

e. Retune frequency control to each MEGACYCLES dial setting recorded in step d. Electronic counter should indicate within $\pm 0.1\%$ of indication recorded in step d.

f. Repeat steps d. and e. for FREQUENCY RANGE B through E.

Table 5-1. Test Equipment Required for Maintenance

Instrument	Critical Specifications	Recommended Model
Electronic Counter	Frequency Range: 10 MHz to 445 MHz Accuracy: ±0.005%	HP 5245L with 5253B plug-in unit
Power Meter	Range: 10 μW to 10 mW Accuracy: ±5% of full scale	HP 432A
Thermistor Mount	Frequency Range: 10 to 480 MHz SWR: 1.6 max	HP 478A
Coaxial Attenuator Coaxial Attenuator	Attenuation: 10 dB Attenuation: 20 dB	HP 8491A HP 8492A
Oscillator	Frequency Range: 20 Hz to 30 kHz Envelope Distortion: 0.2% max Output: 1 V rms Output Impedance: 600Ω	HP 200CD
VTVM	Voltage Range: 0.1 mV to 300V Decibel Range: -72 to +52 dB Frequency Range: 20 Hz to 6 MHz	HP 400E
Distortion Analyzer	Range: 5 Hz to 600 kHz Accuracy: ±3%	HP 334A
Deviation Meter	Frequency Range: 50 to 150 MHz Accuracy: ±3% Deviation Range: 0 to 5 kHz	Measurements Corp. Model 140
Power Supply	-2 to -32 V variable	HP 6217A
Oscilloscope	Vertical Bandwidth: 5 MHz Vertical Sensitivity: 5 mV/cm	HP 140A with 1402A and 1420A plug-in units
Adapter	None	UG-201A/U
Crystal Detector	Frequency Range: 10 MHz to 12.4 GHz VSWR: 1.2 max Deviation from Square Law: $<$0.5 dB over a range of at least 30 dB Input Impedance: 50Ω Impedance Output: 15KΩ, 10pf	HP 423A
Dummy Load	Resistance: 100Ω ±10% Wattage: 1/2 W	See Figure 5-2
Pulse Generator	Pulse Width: 10μsec Pulse Amplitude: 10 v peak into 2KΩ Pulse Rise and Decay: 0.02 μsec max Repetition Rate: 50 to 5000 pps	HP 214A
Loop Antenna	Special	See Figure 5-1
Spectrum Analyzer	Freq: 400 MHz Sensitivity: 1 μV. Absolute calibration	HP 140S with 8554L and 8552A Plug-Ins.

Table 5-1. Test Equipment Required for Maintenance (Cont.)

Instrument	Critical Specifications	Recommended Model
DC Ammeter	Range: 15 to 30 mA Accuracy: ±5%	HP 428B
SWR Meter	Sensitivity: at least μv full scale Attenuator Range: 40 dB Attenuator Accuracy: ±0.1 dB	HP 415E
Double Balanced Mixer	Frequency Range: 10 to 480 MHz	HP 10514A
Frequency Comb Generator	Frequency Range: 10 to 480 MHz Comb Frequency: 1 MHz	HP 8406A
Filter	Cutoff Frequency: 100 kHz	
Frequency Meter	Discriminator Output: 100 kHz/V Disc. Out Accuracy: Better than 1% Internal Filter: 10 kHz, low pass	HP 5210A
Oscilloscope	Bandwidth: 0 to 20 MHz Vert Sensitivity: 50 μV/cm	HP 140 with 1406A plug-in unit
LAB Dual Range, DC Power Supply	Output: 0 to 20 Vdc	HP 6204B
Electronic Counter	Resolution: 5 digits Function: Frequency to > 350 MHz Input Impedance: 50 ohms	HP 5246L with 5252A plug-in unit
Synchronizer	Compatible with the 608F	HP 8708A

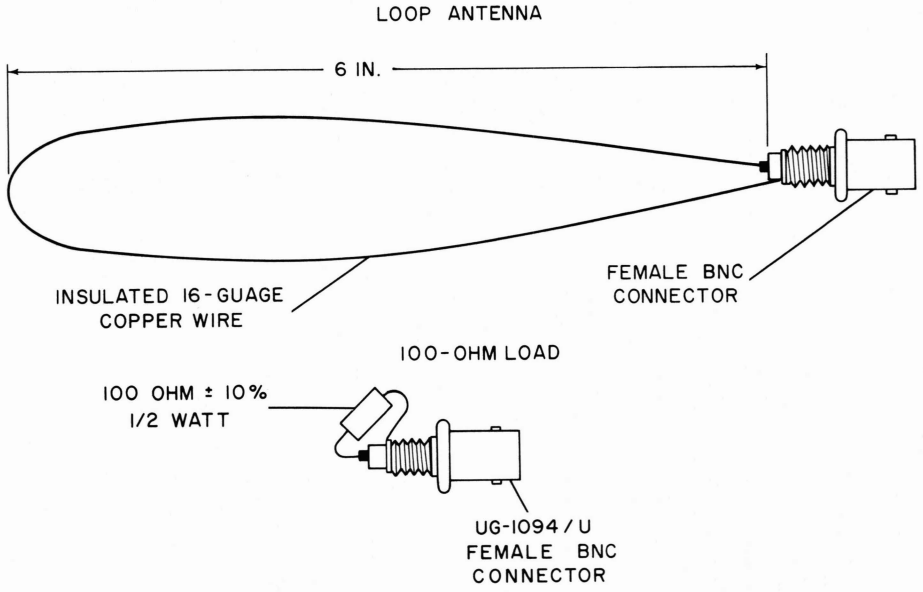


Figure 5-1. Fabricated Test Equipment

Table 5-2. Lubrication Chart

Lubrication Point (see Figure 5-2)	Lubricant
Oscillator and amplifier worm gears	"Molykote (type Z)"
AMPL TRIMMER stop mechanism	Light machine oil
AMPL TRIMMER toggle nut	Light machine oil
AMPL TRIMMER drive link	Light machine oil
Amplifier worm drive shaft	Light machine oil
RF Amplifier sliding coupler	Light machine oil
Attenuator pulleys	Light machine oil
Attenuator drive shaft bearing (front)	Light machine oil
Attenuator drive shaft bearing (rear)	Light machine oil

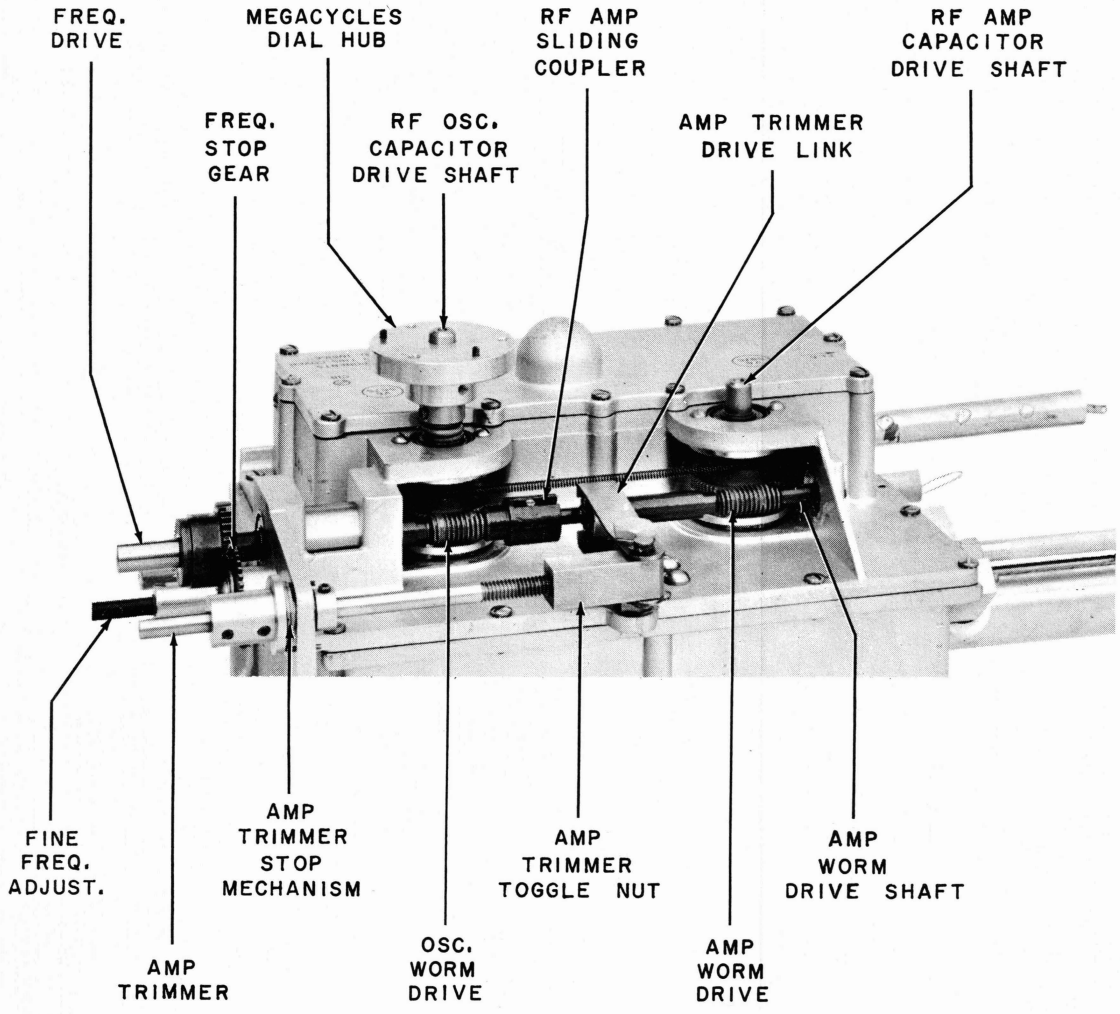


Figure 5-2. Lubrication Points, RF Tuner Drive Mechanism

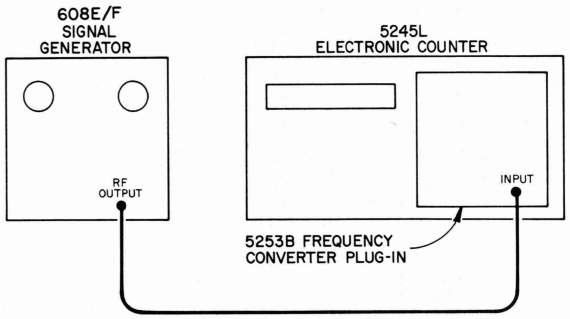


Figure 5-3. Frequency Accuracy and Resettability Test Setup

5-13. CALIBRATOR ACCURACY TEST.

a. Connect signal generator in test setup illustrated in Figure 5-3.

b. Set FREQUENCY RANGE switch to range E.

c. Set XTAL CAL switch to 5 MC position.

d. Plug headset into XTAL CAL OUTPUT connector.

e. Adjust Model 608E frequency control for MEGACYCLES dial reading of 480 MHz, or Model 608F for MEGACYCLES dial reading of 455 MHz.

f. Adjust RF OUTPUT and attenuator controls for proper triggering of electronic counter.

g. Readjust frequency control for zero beat in headset. Adjust XTAL CAL GAIN control as required.

h. Electronic counter should indicate within ±0.01% (±48 kHz) of 480 MHz in Model 608E, or ±0.01% (±45.5 kHz) of 455 MHz in Model 608F.

i. Set XTAL CAL switch to 1 MC position.

k. Adjust frequency control on Model 608E or 608F for MEGACYCLES dial reading of 270 MHz.

l. Repeat steps f. and g. Electronic counter should indicate within ±0.01% (±27 kHz) of 270 MHz.

5-14. FREQUENCY DRIFT TEST.

a. Connect signal generator in test setup illustrated in Figure 5-3.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust frequency control for a MEGACYCLES dial reading of 15 MHz.

d. Adjust RF OUTPUT and attenuator controls for proper triggering of electronic counter. Allow signal generator to stabilize.

e. Record electronic counter indication.

f. Wait 10 minutes and again record electronic counter indication. Frequency should be within ±0.005% (±750 Hz) of the indication recorded in step e.

g. Repeat steps e. and f. for the following FREQUENCY RANGE and MEGACYCLES dial settings:

FREQ RANGE	FREQ.	DRIFT
B	30 MHz	±1.50 kHz
C	75 MHz	±3.75 kHz
D	150 MHz	±7.50 kHz
E	340 MHz	±17.00 kHz

5-15. RESIDUAL FM TEST.

a. Connect signal generator in test setup illustrated in Figure 5-4.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust frequency control for MEGACYCLES dial reading of 10 MHz.

d. Adjust RF OUTPUT and AMPL TRIMMER controls for a +7 dBm (ATTENUATOR CALIBRATED) indication on RF OUTPUT meter.

e. Adjust attenuator control for output setting of 0 dBm.

f. Readjust frequency control for a 50-kHz indication on frequency meter.

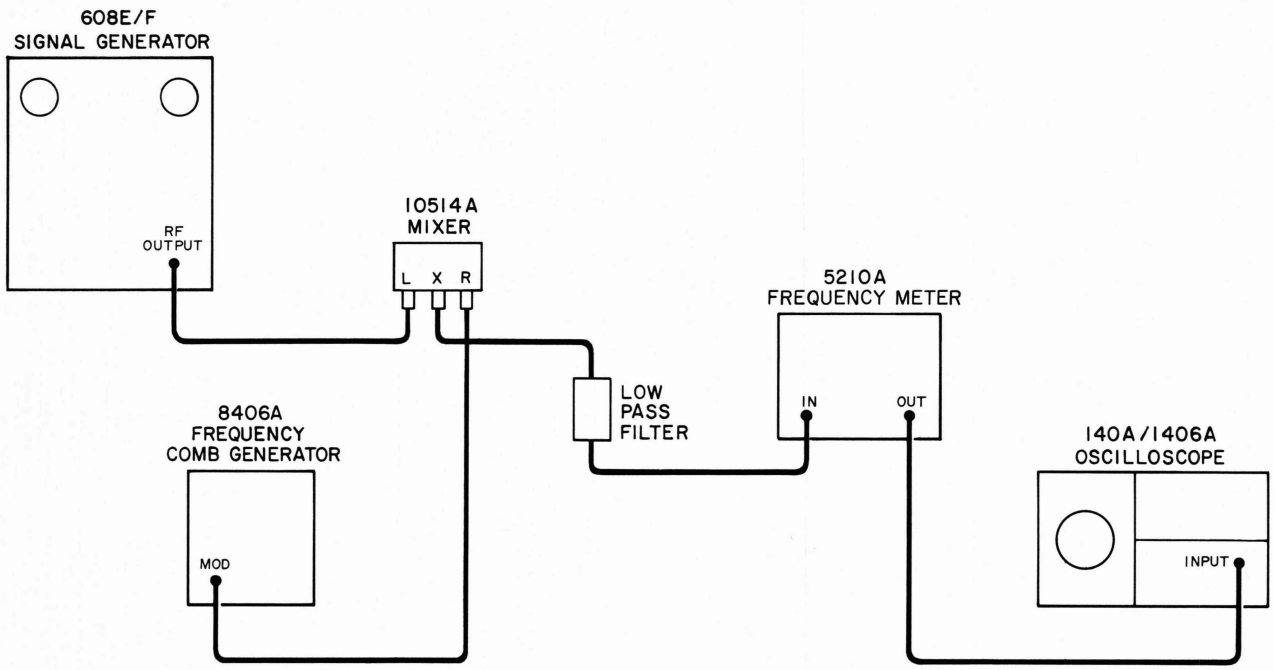


Figure 5-4. Residual and Incidental FM Test Setup

g. Measure peak-to-peak amplitude of signal displayed on oscilloscope. Measurement should not exceed 100 μV peak-to-peak (10 Hz peak-to-peak maximum deviation).

h. Repeat steps d. through f. at the FREQUENCY RANGE and MEGACYCLES dial settings listed with applicable oscilloscope indications in the following chart.

FREQ. RANGE	FREQ.	OSCILLOSCOPE INDICATION	
		RESIDUAL FM	MAXIMUM DEV
B	30 MHz	300 μV pk-pk	30 Hz pk-pk
C	70 MHz	700 μV pk-pk	70 Hz pk-pk
D	150 MHz	1.5 mV pk-pk	150 Hz pk-pk
E	300 MHz	3 mV pk-pk	300 Hz pk-pk
E	400 MHz	4 mV pk-pk	400 Hz pk-pk
E	420 MHz	4.2 mV pk-pk	420 Hz pk-pk
E	450 MHz (608E)	4.5 mV pk-pk	450 Hz pk-pk
E	455 MHz (608F)	4.55 mV pk-pk	455 Hz pk-pk
E	480 MHz (608E)	4.8 mV pk-pk	480 Hz pk-pk

5-16. INCIDENTAL FM TEST.

a. Connect signal generator in test setup illustrated in Figure 5-4.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust frequency control for MEGACYCLES dial setting of 10 MHz.

d. Adjust RF OUTPUT and AMPL TRIMMER controls for a +7 dBm (ATTENUATOR CALIBRATED) indication on RF OUTPUT meter.

e. Set MODULATION switch to INT 1000 ~ position.

f. Adjust MODULATION control for a 50% indication on PERCENT MODULATION meter.

g. Adjust attenuator control for output of 0 dBm.

h. Readjust frequency control for a 50-kHz indication on frequency meter.

i. Measure peak-to-peak amplitude of signal displayed on oscilloscope. Measurement should not exceed 2.0 mV peak-to-peak (200 Hz peak-to-peak maximum deviation).

j. Repeat steps h. and i. at the FREQUENCY RANGE and MEGACYCLES dial settings listed with applicable oscilloscope indications in the following chart.

5-17. MAXIMUM RF OUTPUT TEST.

a. Connect signal generator in test setup illustrated in Figure 5-5.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust RF OUTPUT control to the full clockwise position.

d. Adjust attenuator control to the full clockwise position.

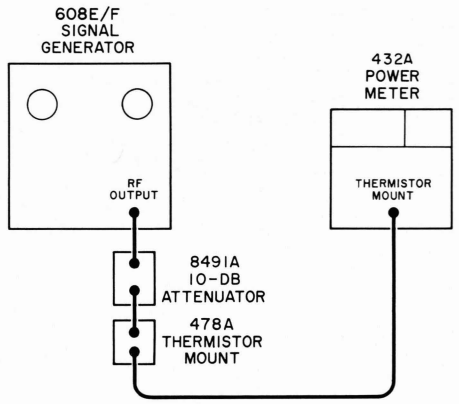


Figure 5-5. RF Output Test Setup

FREQ. RANGE	FREQ	OSCILLOSCOPE INDICATION	
		INCIDENTAL FM	MAXIMUM DEV
B	30 MHz	.6 mV pk-pk	600 Hz pk-pk
C	70 MHz	1.4 mV pk-pk	1400 Hz pk-pk
D	150 MHz	2.0 mV pk-pk	2000 Hz pk-pk
E	300 MHz	2.0 mV pk-pk	2000 Hz pk-pk
E	400 MHz	2.0 mV pk-pk	2000 Hz pk-pk
E	420 MHz	2.0 mV pk-pk	2000 Hz pk-pk
E	450 MHz (608E)	2.0 mV pk-pk	2000 Hz pk-pk
E	455 MHz (608F)	2.0 mV pk-pk	2000 Hz pk-pk
E	480 MHz (608E)	2.0 mV pk-pk	2000 Hz pk-pk

e. Rotate frequency control through entire limits of range A. Depress and tune AMPL TRIMMER control when necessary during tuning cycle to keep the rf output peaked.

f. Observe power meter for minimum output during tuning cycle. Indication should be a minimum of +3 dBm over the range for the 608E, and -3 dBm across the range for the 608F.

g. Repeat steps e. and f. for frequency ranges B through E.

5-18. FREQUENCY RESPONSE AND LEVELING TEST.

a. Connect signal generator in test setup illustrated in Figure 5-5.

b. Set FREQUENCY RANGE switch to range D.

c. Adjust frequency control for a MEGACYCLES dial reading near center of frequency range D.

d. Adjust attenuator control for a dial reading of +7 dBm.

e. Adjust RF OUTPUT control approximately one-quarter turn from counter-clockwise stop.

f. Adjust AMPL TRIMMER control-knob arrow to eight-o'clock position and tune (without depressing) slowly clockwise. RF OUTPUT meter needle should follow right and kick back suddenly. Stop tuning AMPL TRIMMER control when needle kicks.

g. Adjust RF OUTPUT control for an RF OUTPUT meter indication of +7 dBm (ATTENUATOR CALIBRATED).

h. Vary Frequency Control a few megacycles either side of MEGACYCLES dial setting made in step c. If RF OUTPUT meter needle does not lock on +7 dBm, slowly readjust RF OUTPUT and AMPL TRIMMER controls until needle remains at +7 dBm position.

i. Vary frequency control across frequency range D. Peak-to-peak power meter variation should be less than ±1 dBm over range and RF OUTPUT meter needle should remain at +7 dBm position.

j. Repeat steps c. through i. for frequency ranges A through C and range E.

5-19. RF OUTPUT ACCURACY TEST.

a. Connect signal generator in test setup illustrated in Figure 5-5 omitting 8491A 10-DB Attenuator.

b. Set FREQUENCY RANGE switch to range C.

c. Adjust frequency control for MEGACYCLES dial reading of 70 MHz.

d. Depress and adjust AMPL TRIMMER control for maximum indication RF OUTPUT meter.

e. Adjust RF OUTPUT control for +7 dBm (ATTENUATOR CALIBRATED) indication on RF OUTPUT meter.

f. Set attenuator control to 0 dBm position. Power meter should indicate 0 dBm ±1 dB.

5-20. UNCALIBRATED RF OUTPUT TEST.

a. Connect signal generator in test setup illustrated in Figure 5-6.

b. Model 608E should provide indication of -1.8 dBm minimum on power meter. Model 608F should provide power meter indications as follows:

10 to 215 MNz:	-1.8 to +7.0 dBm
215 to 400 MHz:	+2.0 to +6.0 dBm
400 to 450 MHz:	+1.0 to +5.0 dBm

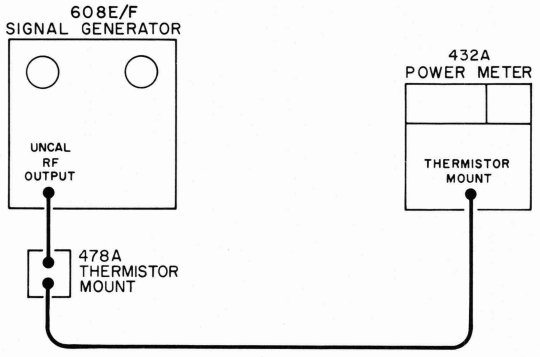


Figure 5-6. Uncalibrated RF Output Test Setup

5-21. EXTERNAL SINE-WAVE MODULATION AND MODULATION METER TEST.

a. Connect signal generator in test setup illustrated in Figure 5-7.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust frequency control for MEGACYCLES dial reading of 15 MHz.

d. Set MODULATION switch to EXT AM position.

e. Adjust oscillator for a 2-kHz, 1-volt rms output as observed on VTVM.

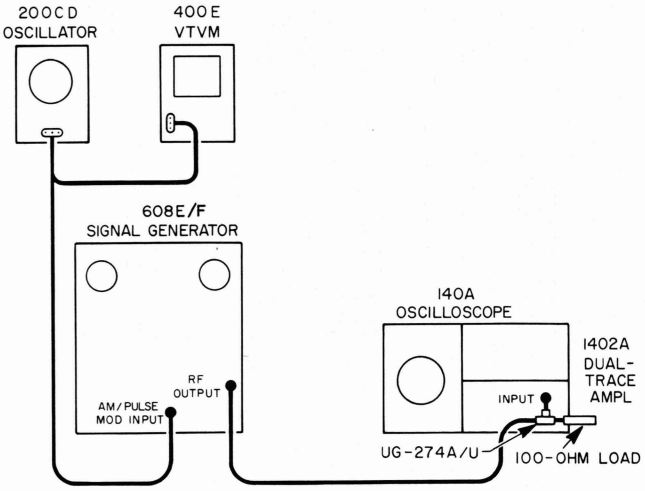


Figure 5-7. External Sine-Wave Modulation and Modulation Meter Test Setup

f. Adjust MODULATION control maximum clockwise. PERCENT MODULATION meter should indicate 95% modulation.

g. Adjust MODULATION control for 90% modulation indication on PERCENT MODULATION meter.

h. Adjust oscilloscope gain for envelope amplitude of 10 cm peak-to-peak.

i. Measure peak-to-peak amplitude (in centimeters) of modulation envelope from uppermost peak to uppermost trough. Amplitude should be 4.5±0.5 cm (90 ±10% modulation).

j. Repeat steps g. through i. to test the following modulation percentages:

Percent Modulation Meter (%)	Amplitude (cm)	Equivalent Modulation Percentage (%)
80	4.0 ± 0.25	80 ± 5
70	3.5 ± 0.25	70 ± 5
60	3.0 ± 0.25	60 ± 5
50	2.5 ± 0.25	50 ± 5
40	2.0 ± 0.25	40 ± 5
30	1.5 ± 0.25	30 ± 5
20	1.0 ± 0.25	20 ± 5
10	0.5 ± 0.25	10 ± 5

5-22. INTERNAL MODULATION TEST.

a. Set FREQUENCY RANGE switch and frequency control to any desired position.

b. Adjust the RF OUTPUT control for ATTENUATOR CALIBRATED condition.

c. Adjust Attenuator control for 0 dBm.

d. Set MODULATION switch to INT 1000 ∿ position.

e. Adjust MODULATION control clockwise and PERCENT MODULATION meter should indicate at least 95% modulation.

f. Adjust MODULATION control to maximum counter-clockwise position. PERCENT MODULATION meter should indicate 0%.

g. Set MODULATION switch to INT 400 ∿ position.

h. Repeat steps e and f.

5-23. ENVELOPE DISTORTION TEST.

a. Connect signal generator in test setup illustrated in Figure 5-8.

b. Set FREQUENCY RANGE switch to range C and adjust frequency control for a MEGACYCLES dial reading of 70 MHz.

c. Set MODULATION switch to CW position.

d. Adjust RF OUTPUT control for indication on RF OUTPUT meter.

e. Depress and tune AMPL TRIMMER control for peak indication on RF OUTPUT meter.

f. Readjust RF OUTPUT control for +7 dBm (ATTENUATOR CALIBRATED) indication on RF OUTPUT meter.

g. Adjust oscillator for a 10 kHz, 1 V rms, output.

h. Set MODULATION switch to AM position.

i. Adjust MODULATION control for 30% modulation indication on PERCENT MODULATION meter.

j. Measure distortion using 334A Distortion Analyzer.

k. Adjust MODULATION control for 70% modulation and measure distortion at desired frequencies.

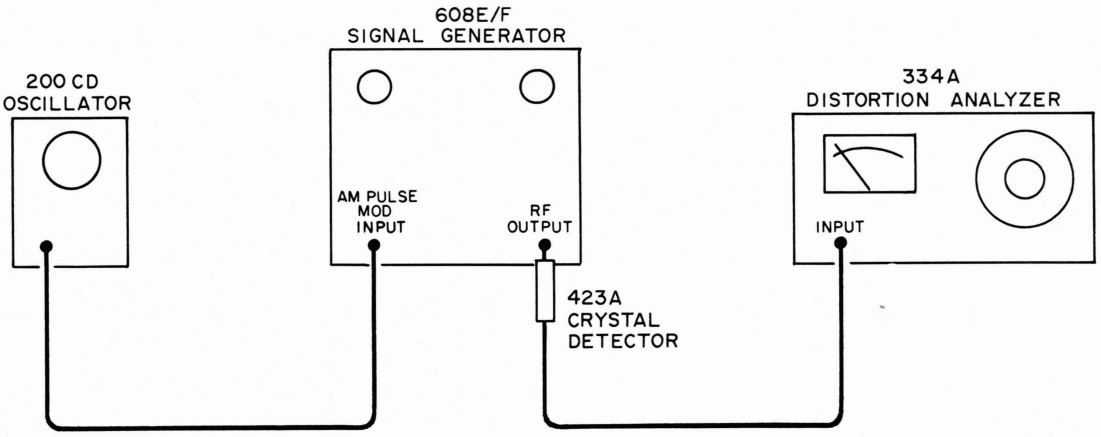


Figure 5-8. Envelope Distortion Test Setup

5-24. EXTERNAL PULSE MODULATION AND RESIDUAL LEVEL TEST.

a. Connect signal generator in test setup illustrated in Figure 5-9.

b. Set FREQUENCY RANGE switch to range C.

c. Adjust frequency control for a MEGACYCLES dial reading of 44 MHz.

d. Set MODULATION switch to PULSE SET RF LEVEL position.

e. Adjust RF OUTPUT control for indication on RF OUTPUT meter.

f. Depress and adjust AMPL TRIMMER control for peak indication on RF OUTPUT meter.

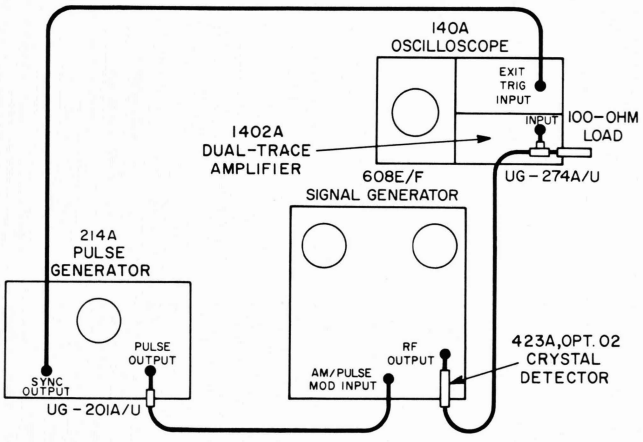


Figure 5-9. Pulse Modulation Test Setup

g. Readjust RF OUTPUT control for a +7 dBm (ATTENUATOR CALIBRATED) indication on RF OUTPUT meter.

h. Adjust attenuator control for output indication of +7 dBm.

i. Set MODULATION switch to PULSE position.

j. Adjust pulse generator for 10-volt peak-to-peak output, 10 sec wide.

k. Oscilloscope should indicate a combined pulse rise and decay time of 4 μsec maximum and a pulse width of 10 $\pm$1.5 μsec.

l. Set FREQUENCY RANGE switch to range E.

m. Adjust frequency control for MEGACYCLES dial setting of 220 MHz.

n. Repeat steps d. through k.

o. Connect signal generator in test setup illustrated in Figure 5-5 omitting 10-dB attenuator.

p. Repeat steps d. through h.

q. Set MODULATION switch to PULSE position. Power meter should indicate -13 dB minimum.

5-25. RF LEAKAGE TEST.

a. Connect signal generator in test setup illustrated in Figure 5-10.

b. Set FREQUENCY RANGE switch to range E.

c. Adjust frequency control for MEGACYCLES dial reading of 400 MHz.

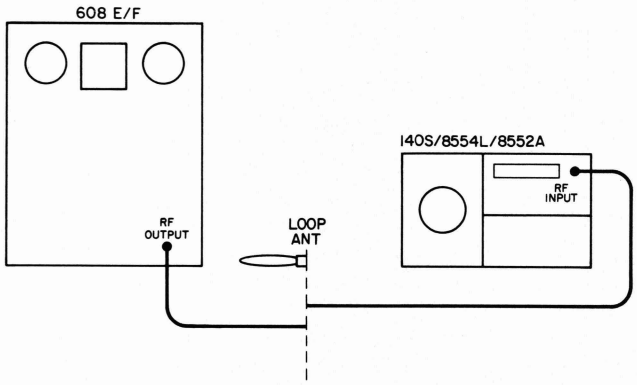


Figure 5-10. RF Leakage Test Setup

d. Set MODULATION switch to CW position.

e. Adjust RF output control for ATTENUATOR CALIBRATED condition.

f. Adjust Attenuator control for 1 μV output.

g. Adjust spectrum analyzer for reference of 1 μV.

h. Disconnect the cable from signal generator RF OUTPUT connector.

i. Connect loop antenna (see Figure 5-1) to cable.

j. Probe with loop antenna over entire signal generator cabinet area. The spectrum analyzer indication should not exceed 1 μV.

5-26. FREQUENCY CONTROL INPUT TEST (MODEL 608F ONLY).

a. Connect signal generator in test setup illustrated in Figure 5-11.

b. Set FREQUENCY RANGE switch to range A.

c. Adjust frequency control for MEGACYCLES dial reading of 10 MHz.

d. Connect power supply and adjust for -2 Vdc at FREQ CONTROL INPUT. NOTE frequency counter reading.

e. Adjust power supply for -32 Vdc at FREQ CONTROL INPUT. The frequency counter should indicate a frequency change of more than 0.2%, or 20 kHz.

f. Set frequency to high end of range A, 21 MHz.

g. Return power supply voltage to -2 Vdc at the FREQ CONTROL INPUT. The frequency counter should indicate a frequency change of more than 1%, or 210 kHz.

h. Repeat this test on other bands of interest.

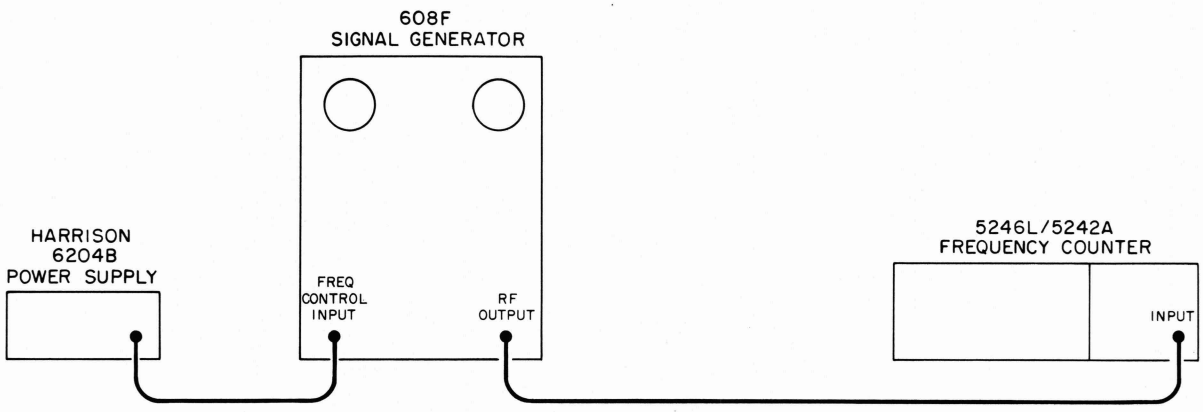


Figure 5-11. Frequency Control Input Test Setup

5-27. FREQUENCY ANALOG OUTPUT TEST (MODEL 608F ONLY).

a. Connect ohmmeter to FREQ ANALOG OUTPUT jack on signal generator.

b. Rotate frequency control for a MEGACYCLES dial reading at the extreme low end. Ohmmeter should indicate between 2500 and 3500 ohms.

c. Rotate frequency control for a MEGACYCLES dial reading at the extreme high end. Ohmmeter should indicate zero ohms.

5-28. SYNCHRONIZATION TEST WITH MODEL 8708A SYNCHRONIZER (MODEL 608F).

a. Connect signal generator in test setup illustrated in Figure 5-12.

b. Set 608F and 8708A controls as follows:

608F

FREQUENCY RANGE . . . . . A
FREQUENCY . . . . . high end of band
MODULATION switch . . . . . CW

8708A

FREQ RANGE . . . . . A
FREQ TUNING . . . . . centered
MODULATION . . . . . CW

c. The 8708A meter will stop searching, indicating that phase lock is established.

d. Slowly tune 608F across band A. The 8708A meter pointer will move to left, indicating that the FREQ CONTROL OUTPUT voltage is changing to maintain phase lock. When end-of-lock range is reached, the 8708A meter pointer will jump to right indicating phase-lock is re-established on the next lock point. On the oscilloscope, the dc level will shift to approximately +3.0 V when the frequency is increased, and approximately -1.0 V when the frequency is decreased. The oscilloscope trace should not jump past the reference trace (this indicates weak locking due to either 608F or the 8708A).

e. Repeat steps c. and d. for frequency ranges B through E.

5-29. ADJUSTMENT.

5-30. The following procedures list the internal adjustments necessary for proper operation of the signal generator. The test equipment required to perform the adjustments are contained in Table 5-1.

WARNING

Performance of the following routines require that the dust cover be removed from the signal generator. Lethal voltages exist within the unit. Exercise extreme caution when performing the procedures.

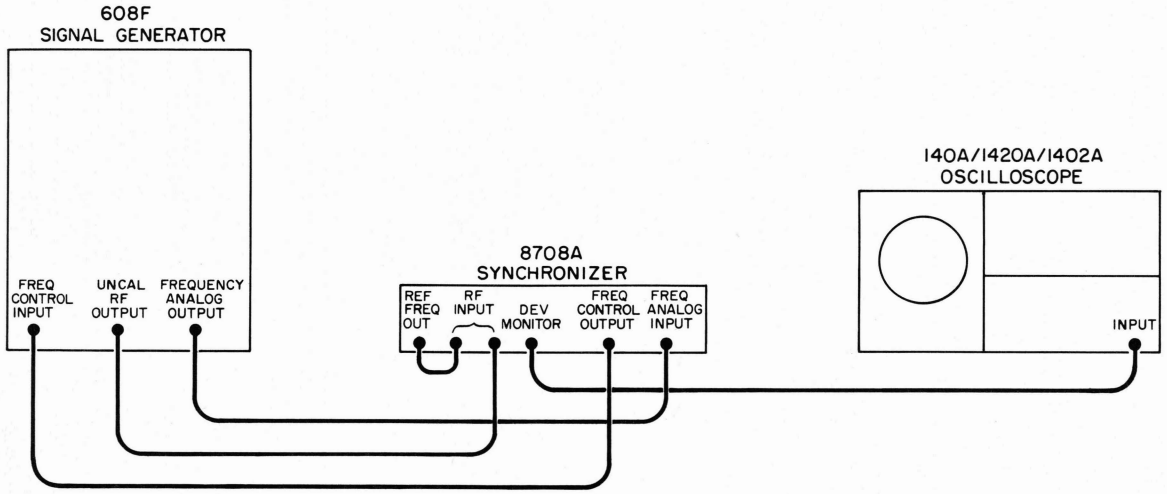


Figure 5-12. Synchronization Test Setup

5-31. POWER SUPPLY VOLTAGE ADJUSTMENTS.

5-32. There are four adjustable dc operating voltages: -165, +225, +25, and -6.3 volts. Adjust these voltages only if proven by accurate measurement to be outside the tolerances specified below and only if voltage error is not caused by excessive current drawn through the regulator or by inadequate voltage supplied to the regulator from the power supply rectifiers.

5-33. Because of the interdependence of these power supplies, the -165 volt regulator must be set first, the +225 volt regulator second, and the +25 and -6.3 volt regulators last. After adjusting any of these regulators, check the output voltage of each other regulator to be sure it is still within specified tolerances.

a. Connect an adjustable transformer to control line voltage applied to the signal generator.

b. Set signal generator controls as follows:

MODULATION control	max. ccw
RF OUTPUT	max. ccw
FINE FREQ	centered
Frequency	high end stop
AMPL TRIMMER	max. cw
MODULATION selector	CW
Attenuator	max. cw
Power switch	ON
XTAL CAL	OFF

c. Adjust line voltage transformer to deliver 115 (or 230) volts. Be sure 115/230 volt switch is set correctly.

d. Measure, and if necessary, adjust the following voltages:

Voltage	Adjustment (Figure 5-13)
-165 ± 5	R80
+225 ± 5	R71
+25 ± 1	Replace CR28 if necessary
-7.2 ± 0.3	Replace CR20 if necessary

5-34. MODULATION METER ADJUSTMENT.

5-35. MECHANICAL ZERO. Adjust mechanical zero as follows:

a. Set MODULATION selector to CW.

b. Connect shorting lead across PERCENT MODULATION meter terminals.

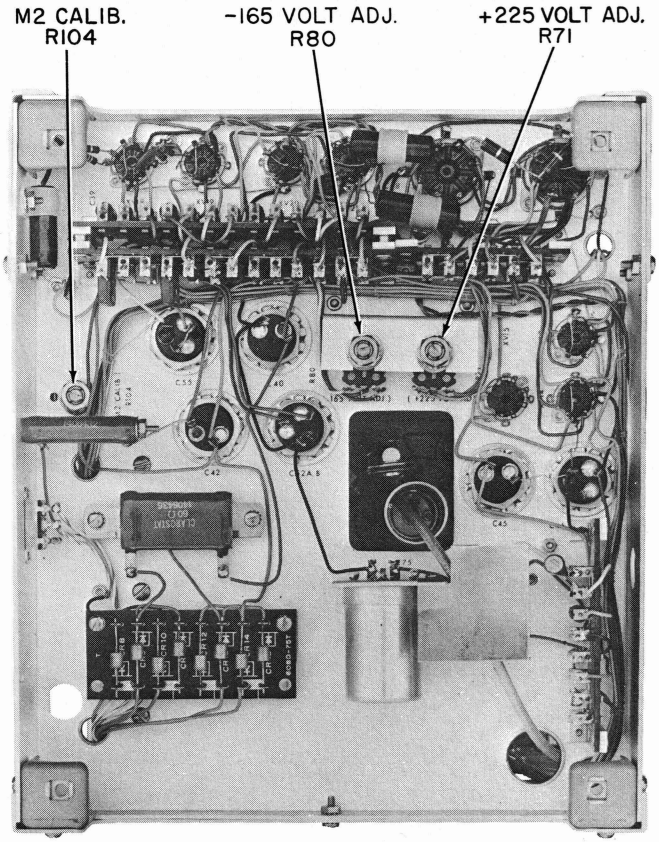


Figure 5-13. Location of Power Supply and Modulation Meter Adjustments

c. Adjust mechanical zero-adjust screw clockwise until pointer is at left of meter zero and moving towards meter zero; stop adjustment when meter needle is exactly at zero. If needle overshoots, repeat adjustment.

d. Carefully adjust mechanical zero-adjust screw a few degrees to free screw from meter suspension. If pointer moves off zero, repeat step c.

e. Remove shorting lead from meter terminals.

5-36. ELECTRICAL ZERO. Adjust electrical zero as follows:

a. Adjust R106 (front-panel ZERO adjustment) fully clockwise. PERCENT MODULATION meter should indicate at least 30% modulation.

b. Adjust line voltage from 102 to 128 (or 204 to 256) volts. PERCENT MODULATION meter indication should not change more than ±10% of full scale.

c. Adjust line voltage to 115 (or 230) volts. Adjust R106 for zero indication on PERCENT MODULATION meter.

5-37. CALIBRATION OF PERCENT MODULATION METER.

5-38. Recalibration of the PERCENT MODULATION meter may be necessary following a repair of the modulation measuring circuits (V18-V21) or after replacement of the meter itself.

NOTE

Be sure the mechanical and electrical zero is adjusted properly; refer to paragraph 5-34.

a. Connect 608E/F and oscilloscope as shown in Figure 5-14.

b. Set the 608E/F controls as follows:

FREQUENCY RANGE . . . . . A band
MEGACYCLES dial . . . . . 10 MHz
MOD. SELECTOR . . . . . 1000 ∿
AMP. TRIMMER . . . Adjust for maximum output
RF OUTPUT. . . . ATTENUATOR CALIBRATED
MODULATION. . . . . Fully CCW

c. Set the 140/1420/1402 oscilloscope as follows:

VERT. SENS . . . . . 0.2 V/cm
HOR. SWEEP TIME . . . . . 0.2 ms/cm
TRIGGER SOURCE . . . . . + INT or - INT

d. Adjust vertical position to place pattern at center of screen.

e. Adjust 608E/F Attenuator for a 4 cm pattern on screen.

5-39. ADJUSTMENTS.

a. Increase MODULATION control until sine wave pattern appears on oscilloscope. Adjust trigger level for stable pattern.

b. Increase MODULATION control until peak-to-peak pattern is 6 cm high, as shown in Figure 5-15. Adjust R104 (METER CAL on rear panel) for a reading of 50% on the PERCENT MODULATION meter.

c. Increase MODULATION control until the peak-to-peak pattern is 8 cm high. Adjust trigger level as necessary to keep stable pattern. The PERCENT MODULATION meter should read approximately 100%.

5-40. This check will determine if the modulation meter circuitry (V18-V21) is frequency sensitive. It will also check the relative output of the Modulation Oscillator (V2).

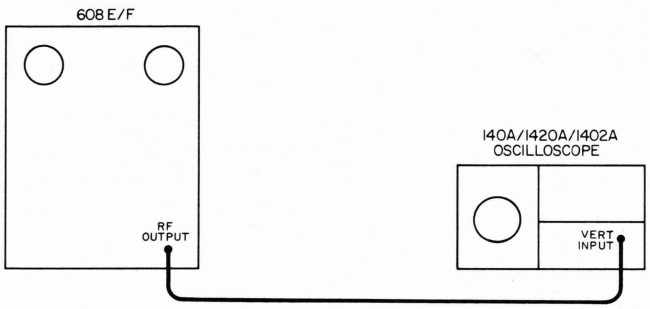


Figure 5-14. Modulation Meter Calibration Test Setup

a. Return the MODULATION control to a meter reading of 50%.

b. Turn the MOD. SELECTOR switch to 400 ∿. Meter should read ±5% of that obtained in step a.

5-41. AUTOMATIC OUTPUT LEVELING ADJUSTMENT.

a. Connect dc voltmeter (50-volt range) to junction of CR26-R235 (Figure 5-16) and ground.

b. Set RF OUTPUT control fully counterclockwise and MODULATION selector to CW.

c. Adjust R204 (Figure 5-14) to point where dc voltmeter shows no further voltage increase with adjustment of R204.

d. DC voltmeter should indicate greater than 30 volts.

e. Set MODULATION selector to 400 ∿, 1000 ∿, and AM position; dc voltmeter should indicate greater than 30 volts at each switch position.

f. Set MODULATION selector to PULSE/SET RF OUTPUT; voltmeter should indicate greater than 14 volts.

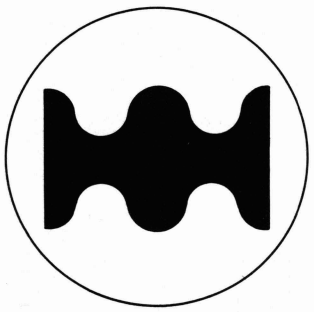


Figure 5-15. Pattern on 140 Oscilloscope at 50% Modulation

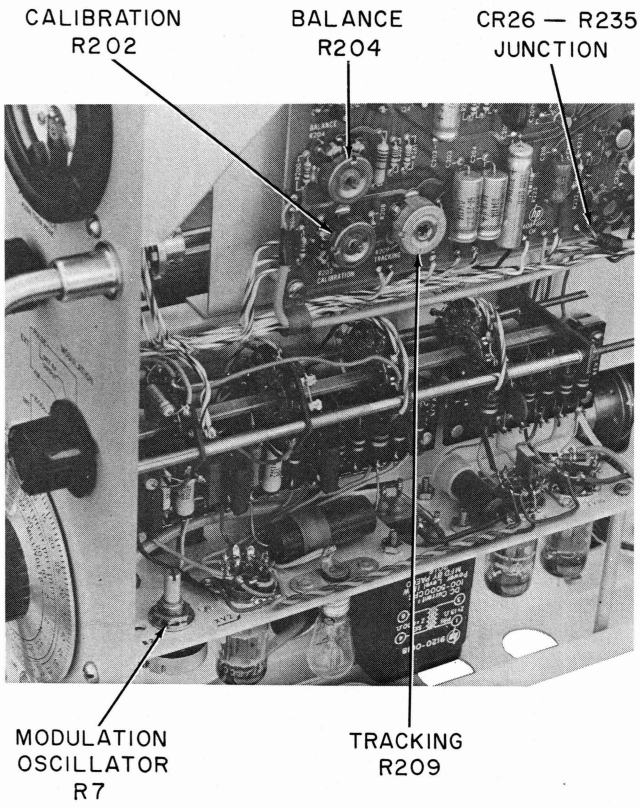


Figure 5-16. Location of Leveling and RF Output Meter Adjustments

g. Set MODULATION selector to PULSE; voltmeter should indicate greater than 25 volts.

h. Set RF OUTPUT control fully clockwise.

i. Set MODULATION selector to CW and PULSE/SET RF OUTPUT positions; dc voltmeter should indicate -0.3 to -1.0 volt dc at each switch position.

j. Set MODULATION selector to PULSE; voltmeter should indicate greater than 20 volts.

5-42. RF OSCILLATOR ADJUSTMENT.

a. Connect signal generator in test setup shown in Figure 5-11 omitting Harrison Power Supply.

b. Set FREQUENCY RANGE switch to band A.

c. Center FINE FREQ and cursor controls.

d. Adjust frequency control for 21 MHz.

e. Check counter frequency indication; counter should indicate 21 MHz ±0.5% (±105 kHz). If not, adjust capacitor C59 (Figure 5-17) for proper counter indication.

f. Repeat steps b. through e. for each of the following frequencies, adjusting C59 for the best compromise at the listed frequencies:

Band	Frequency
B	43 MHz
C	95 MHz
D	210 MHz
E	455 MHz

5-43. UNCALIBRATED RF OUTPUT, MINIMUM RF OUTPUT, AND RF AMPLIFIER TRACKING ADJUSTMENT.

a. Connect signal generator in test setup shown in Figure 5-5, but delete 10-dB attenuator.

b. Set FREQUENCY RANGE switch to band A.

c. Rotate frequency control through entire range plus one-half turn at edges of band, while adjusting AMPL TRIMMER for maximum RF output. Observe Model 432A power meter for following indications:

UNCAL RF OUTPUT (608E): -1.8 dBm minimum

RF OUTPUT (608E): 13 dBm minimum

UNCAL RF OUTPUT (608F): -1.8 dBm minimum 10-215 MHz

+2.0 dBm minimum 215-400 MHz

+1.0 dBm minimum 400-430 MHz

RF OUTPUT (608F): +10 dBm minimum.

NOTE

Although Model 608F is capable of well in excess of its published specification, prolonged use at greater power levels than +7 dBm should be avoided. However, it is usable for a short time to make these adjustments.

d. AMPL TRIMMER control should peak with at least one-quarter turn adjustment at either end.

e. If necessary, the power amplifier tuning coils can be adjusted to obtain the proper output at the RF OUTPUT connector as follows:

Band A: Reposition 3 or 4 turns on coil.

Bands B through D: Reposition shorted turns on coils.

Band E: Spread or compress coil loop.

f. Repeat steps b through d for bands B through E.

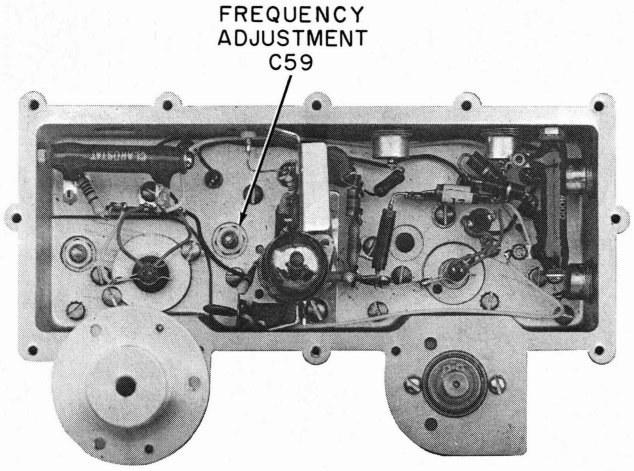


Figure 5-17. Location of RF Oscillator Adjustment

5-44. RF OUTPUT METER ACCURACY ADJUSTMENT.

5-45. MECHANICAL ZERO AND ELECTRICAL ADJUSTMENT.

a. Adjust mechanical zero as follows:

b. Set MODULATION selector to CW.

c. Connect shorting leads across PERCENT MODULATION meter.

d. Adjust mechanical zero-adjust screw clockwise until pointer is at left of meter zero and moving towards meter zero. Stop adjustment when meter needle is exactly on zero. If needle overshoots, repeat adjustment.

e. To electrically calibrate meter, proceed as follows:

f. Connect signal generator in test setup illustrated in Figure 5-5, omitting 10-dB attenuator.

g. Set MODULATION switch to CW position.

h. Set MODULATION control completely counterclockwise.

i. Set FREQUENCY RANGE switch to range C, and adjust frequency control to center mark on MEGACYCLES dial (approximately 75-80 MHz).

j. Adjust RF OUTPUT control for indication on RF OUTPUT meter.

k. Depress and adjust AMPL TRIMMER control for peak indication on RF OUTPUT meter.

m. Readjust RF OUTPUT control for +7 dBm (ATTENUATOR CALIBRATED) indication on RF OUTPUT meter.

n. Adjust Attenuator control for output of -1.0 dBm.

o. Adjust RF OUTPUT control for power meter readings shown below. Calibrate the output meter by adjusting R202 and R209 as indicated.

NOTE

In the Model 608F, the RF OUTPUT meter is calibrated using full-scale deflection when the power meter is indicating +5 dBm. During normal operation only half-scale (+7 dBm) deflection is used, indicating the maximum RF output capabilities of the instrument.

POWER OUTPUT (432A Rdg) dBm	OUTPUT METER Rdg- dB	ADJUST see Figure 5-16
+5.0	+13.0	R202
-4.0	+4.0	R209
+5.0	+13.0	R202
-4.0	+4.0	R209
+2.0	9.8-10.2	
-1.0	6.9-7.2	

5-46. RF OUTPUT METER/ATTENUATOR FREQUENCY RESPONSE AND AUTOMATIC LEVEL OUTPUT ADJUSTMENT.

a. The following steps will indicate if an adjustment is necessary.

b. Connect signal generator in test setup as shown in Figure 5-5, but delete the 10-dB attenuator.

c. Adjust AMPL TRIMMER for best tracking compromise over bands A through D.

d. Adjust RF OUTPUT control for ATTENUATOR CALIBRATED (+7 dBm) indication on meter.

e. Vary frequency control over entire frequency range of bands A through D. The RF OUTPUT meter indication should remain constant within ±1 dB over entire range of bands A through D. There should be no further adjustment of the AMPL TRIMMER necessary, however one readjustment is acceptable (initial setting plus one readjustment) per band.

f. Set FREQUENCY RANGE switch to band E.

g. Adjust frequency control to lower end of band, and adjust AMPL TRIMMER for maximum RF output.

h. Adjust frequency control over lower half of band E. Power meter indication should remain constant within ±1 dB over lower half of band E.

i. Adjust frequency control to middle of band E, and adjust AMPL TRIMMER for maximum RF output.

j. Adjust frequency control over upper half of band E. Power meter indication should remain constant within ±1 dB over upper half of band E.

k. Set attenuator and FREQUENCY RANGE as follows and observe power meter for proper indication:

NOTE

When checking attenuator on band E, readjust AMPL TRIMMER for maximum RF output and then adjust RF OUTPUT control for +7 dBm on RF OUTPUT meter.

Attenuator Setting dBm	Frequency Range Band	Power Output dBm
-1.0	C	0 to -2.0
-1.0	A	0 to -2.0
-1.0	B	0 to -2.0
-1.0	D	0 to -2.0
-1.0	E	0 to -2.0
+7.0	E	+6.0 to +8.0
+7.0	D	+6.0 to +8.0
+7.0	C	+6.0 to +8.0
+7.0	B	+6.0 to +8.0
+7.0	A	+6.0 to +8.0

m. If the power output is not within the above specified limits, proceed as follows:

n. Setup RF OUTPUT meter adjustments as shown in paragraph 5-45.

CAUTION

All readings are referenced to Band C. There are several variables which have to be taken into account. The amplifier coils for bands A through D can be moved closer or further away from the attenuator probe pickup loop. In general, the power level becomes more positive by moving the coils closer to the attenuator, and more negative by moving the coils further away. THERE IS HIGH VOLTAGE ON ALL AMPLIFIER COILS, AND ON THE STATOR OF TUNING CAPACITOR C17. MAKE CERTAIN THAT THERE IS SUFFICIENT CLEARANCE BETWEEN THE COILS AND THE ATTENUATOR PROBE PICKUP LOOP. Band E presents a different problem. The amplifier coil is not adjustable, so the procedure calls for changing the bolometer response to conform to other bands.

o. Check band C and adjust if necessary to bring into specifications.

p. Check E band. If power output is not within specifications, adjust either coil L17 or resistor R60 (see Figures 5-18 and 5-19). After adjusting either L17 or R60, always repeat RF OUTPUT meter adjustments, as in paragraph 5-44.

CAUTION

Some 608E/F instruments may have a large blob of solder on the pigtail lead of R60. This was done at the factory to lessen the effects of lead inductance. This effectively shortens the pigtail lead of R60 without cutting the lead, which may at a later date prove unsatisfactory and necessitate replacement.

q. Check and adjust, if necessary, bands D, B, and A.

5-47. CRYSTAL CALIBRATOR ADJUSTMENT.

a. Remove signal generator chassis from cabinet, and remove side plate from RF generator housing.

b. Plug headset into XTAL CAL OUTPUT jack.

c. Set signal generator controls as follows:

FREQUENCY RANGE . . . . . between bands
XTAL CAL GAIN. . . . . max. cw
XTAL CAL. . . . . 1 MC

d. Adjust L18 (Figure 5-19) in clockwise direction. Two separate beat frequencies should be heard in headset within one full turn of L18. Adjust L18 to audible null between the two beat notes.

e. Set signal generator controls as follows:

FREQUENCY RANGE . . . . . band E
RF OUTPUT control . . . . . max. cw

f. Set XTAL CAL to 5 MC.

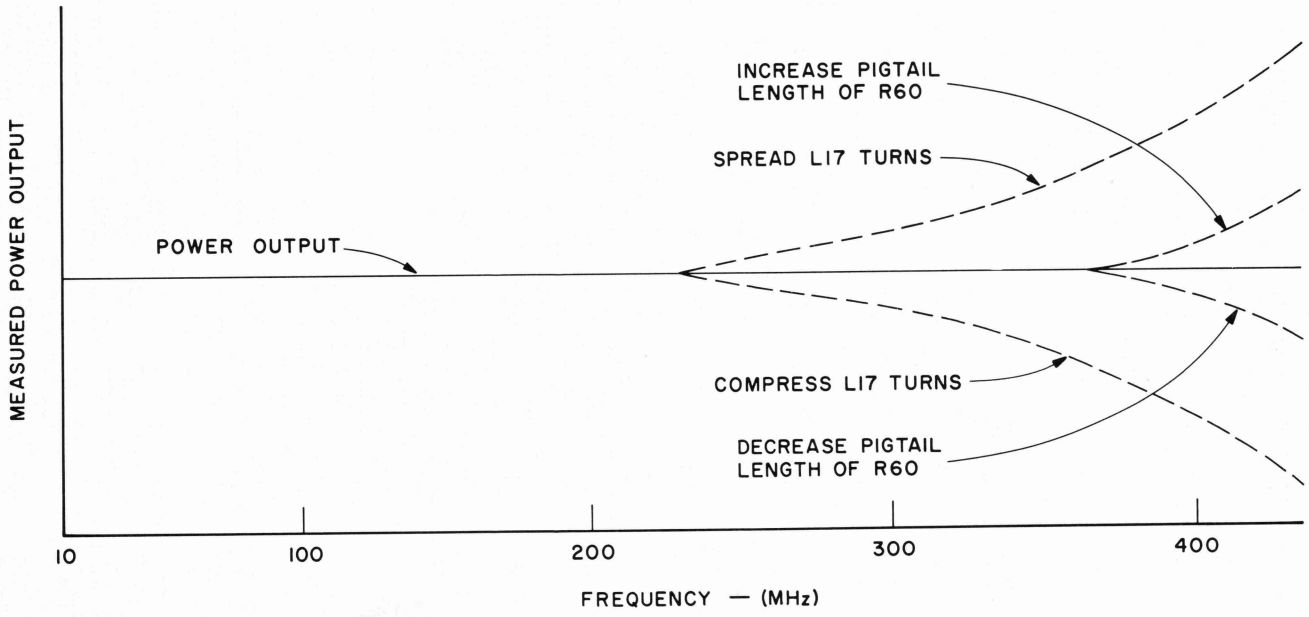


Figure 5-18. Frequency-Response Adjustments

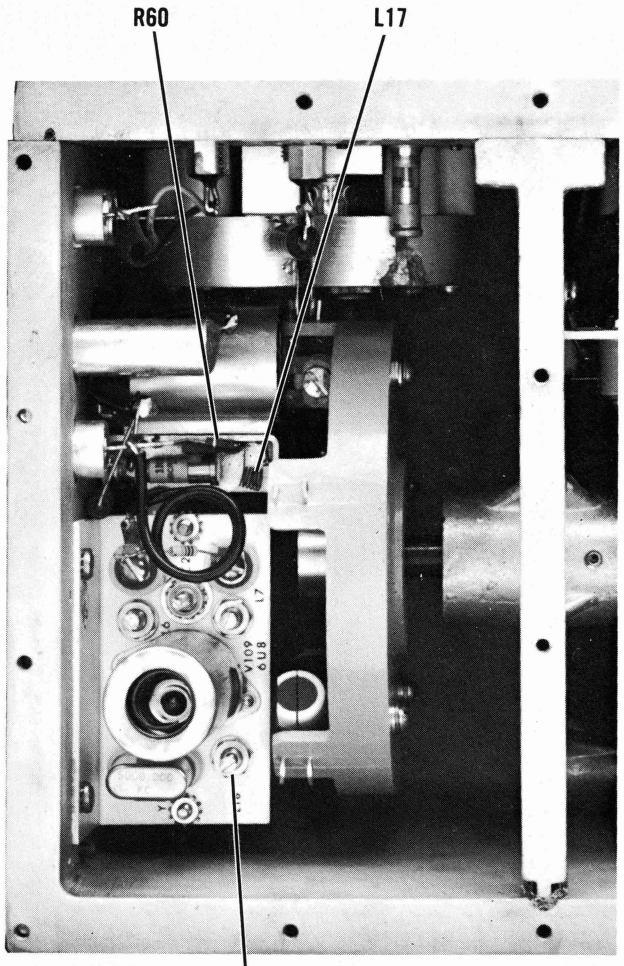


Figure 5-19. Location of Frequency-Response and Crystal-Calibrator Adjustments

g. Adjust frequency control from 450 to 455 MHz. Two beat notes should occur, one at 450 MHz and one at 455 MHz.

5-48. TROUBLESHOOTING.

5-49. The following paragraphs contain information for troubleshooting the signal generators, and procedures for isolating troubles in transistor circuits. The procedures are not intended to correct for small out-of-tolerance conditions, but are directed toward correcting a major fault.

5-50. ISOLATING A TROUBLE TO A CIRCUIT SECTION.

5-51. To isolate a trouble to a particular circuit, a troubleshooting tree (table 5-7) is presented. The tree presents five major problems that can occur during operation of the signal generators, and includes block-to-block instructions for maintenance personnel to trace a malfunction to a particular circuit. Normal shop troubleshooting practices must be employed after the trouble has been isolated to the circuit section.

5-52. As a further aid in circuit troubleshooting the instrument, voltage and resistance measurements are presented in Figures 5-20 and 5-21. Figure 5-20 lists the voltage and resistance measurements during INT 1000 ~ operation, and Figure 5-21 depicts the voltage measurements on the ALC board during CW and PULSE/SET RF OUTPUT operation.

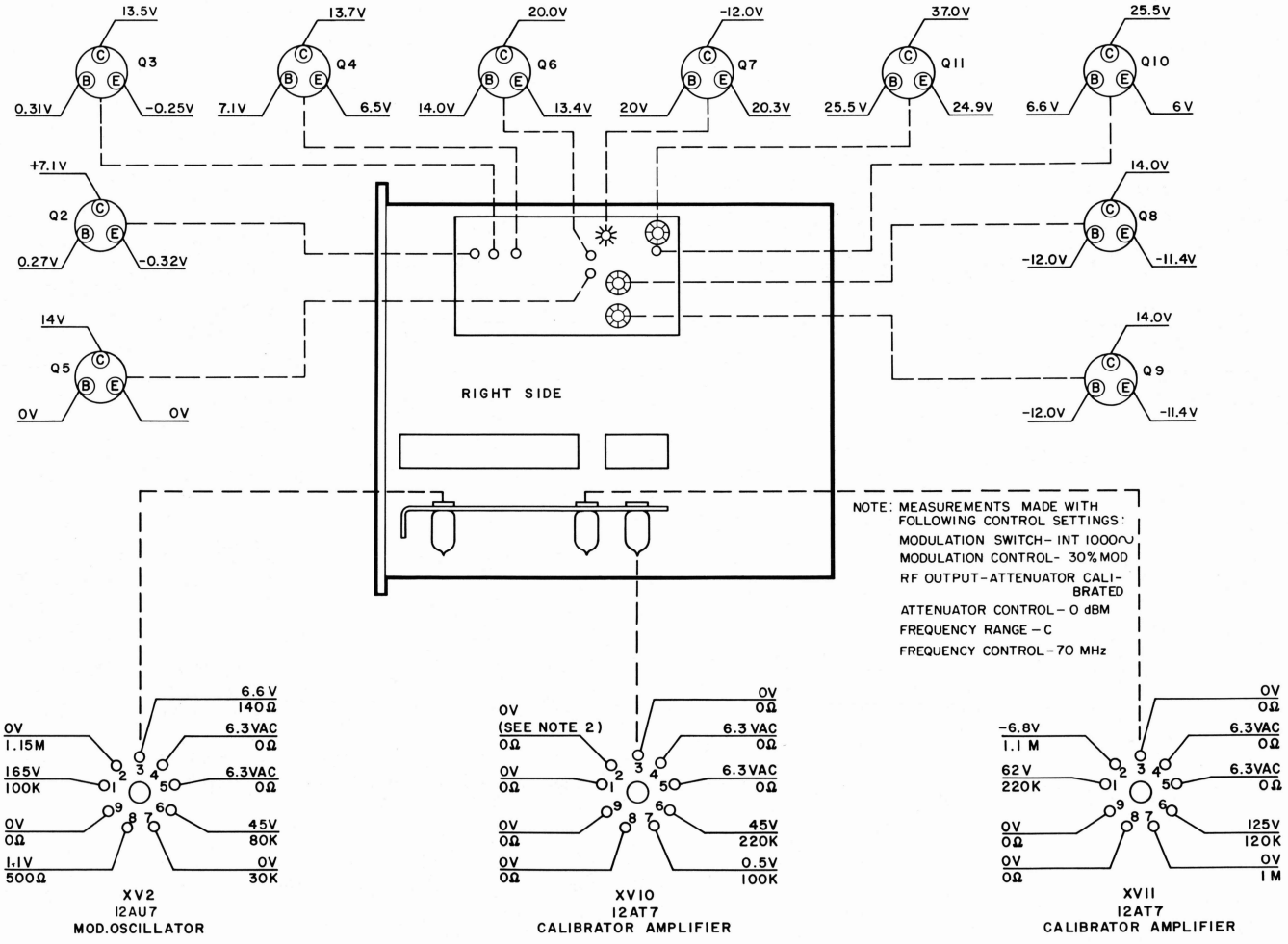


Figure 5-20. Voltage and Resistance Measurements, INT 1000 ~ Operation
(Sheet 1 of 3)

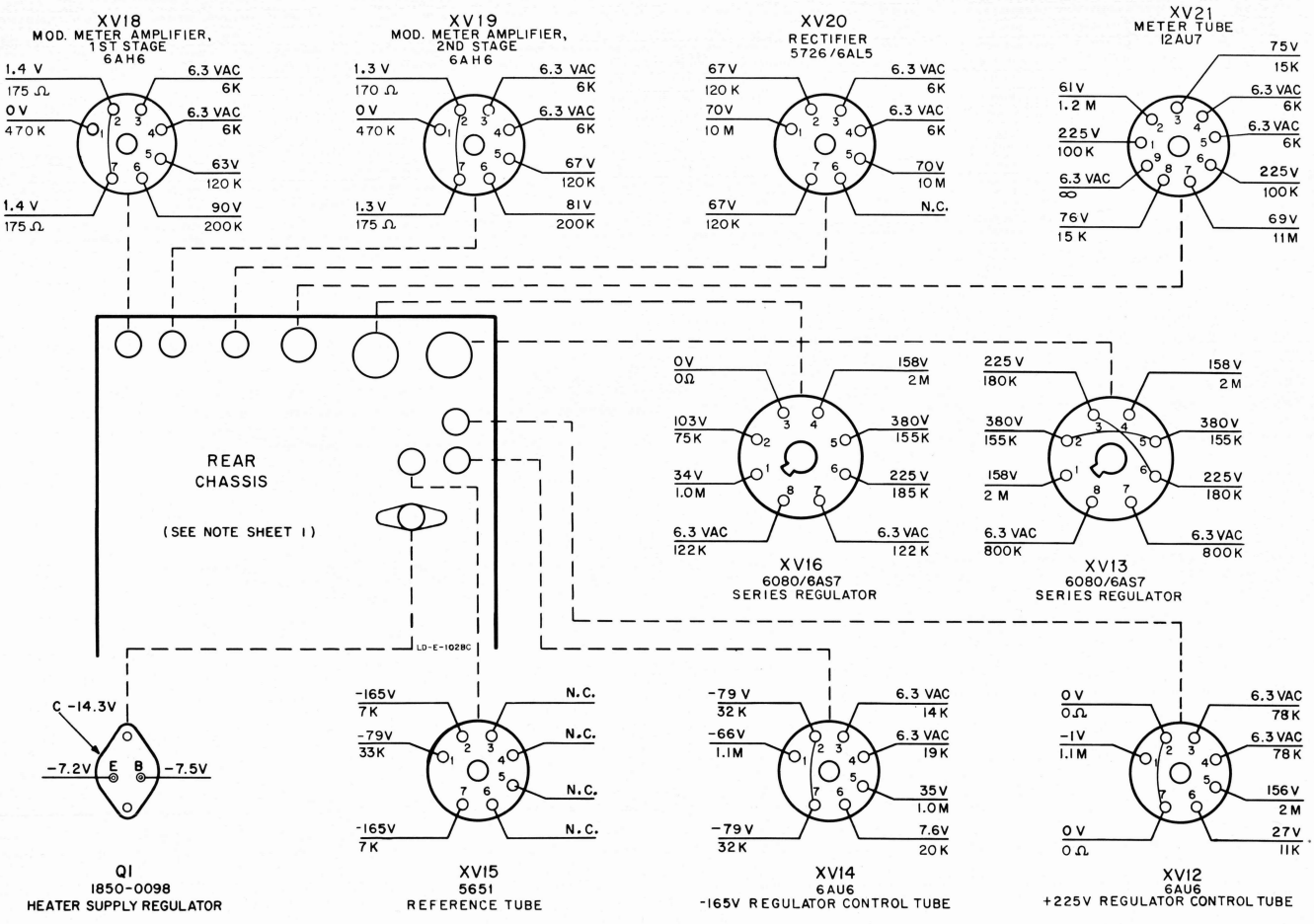
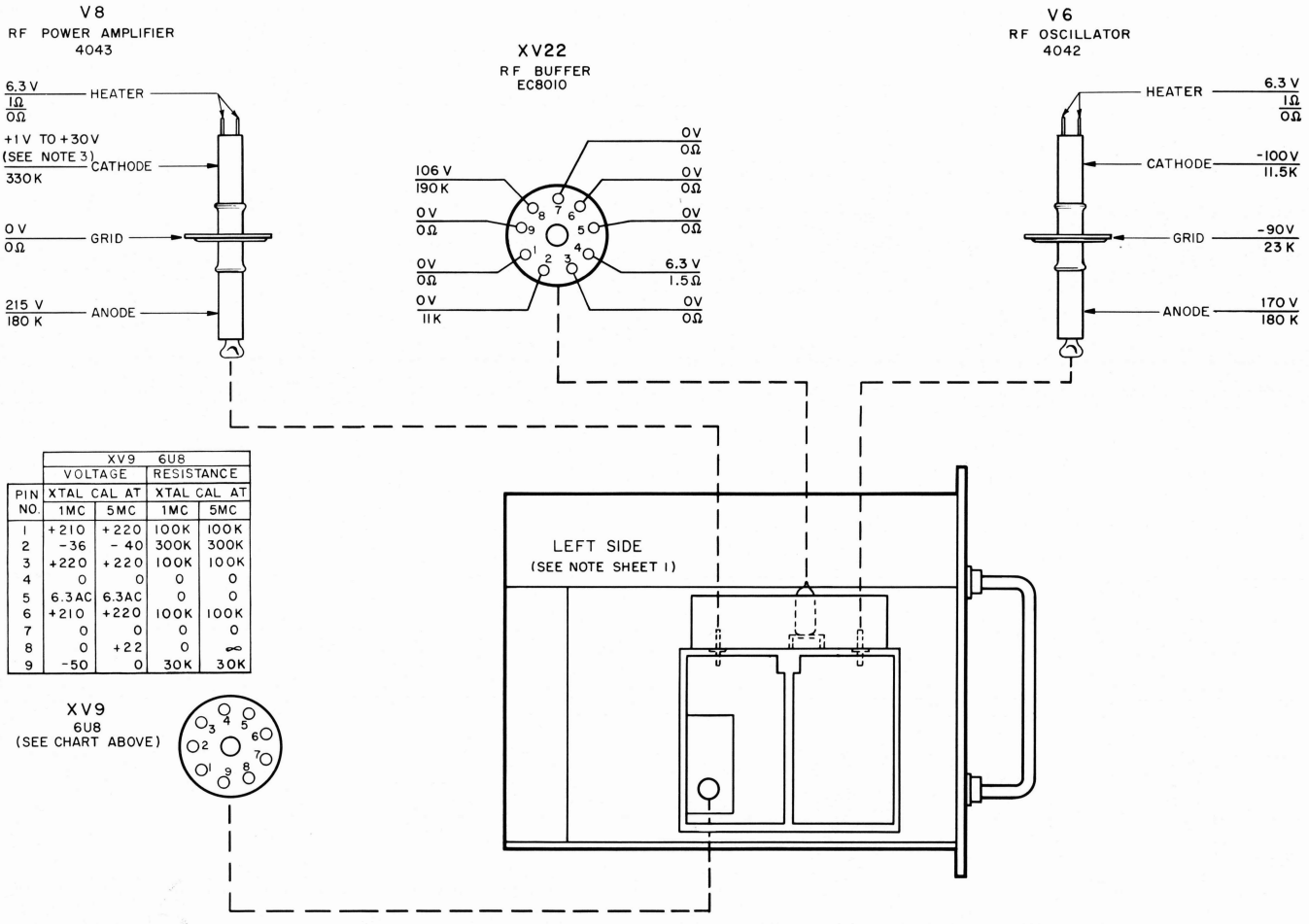
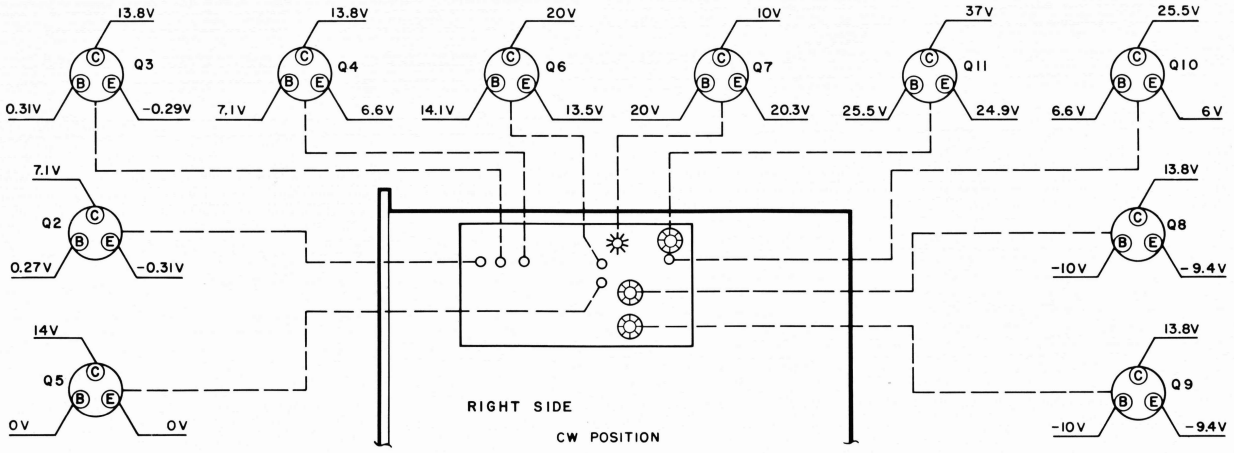


Figure 5-20. Voltage and Resistance Measurements, INT 1000 ~ Operation
(Sheet 2 of 3)



	XV9 6U8			
	VOLTAGE		RESISTANCE	
PIN NO.	XTAL CAL AT		XTAL CAL AT	
	1MC	5MC	1MC	5MC
1	+210	+220	100K	100K
2	-36	- 40	300K	300K
3	+220	+220	100K	100K
4	0	0	0	0
5	6.3AC	6.3AC	0	0
6	+210	+220	100K	100K
7	0	0	0	0
8	0	+22	0	∞
9	-50	0	30K	30K

Figure 5-20. Voltage and Resistance Measurements, INT 1000 ~ Operation
(Sheet 3 of 3)



NOTE: DIAL CONTROL FREQUENCY, RF OUTPUT, AND ATTENUATOR CONTROL SETTINGS SAME AS FIGURE 5-20

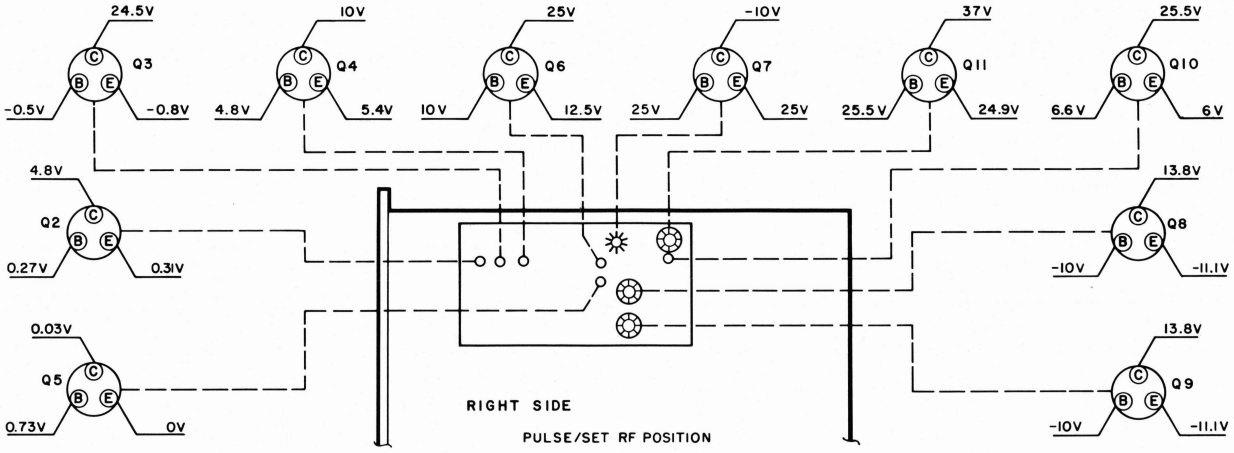


Figure 5-21 ALC Board Voltage and Resistance Measurements, CW and PULSE SET RF OUTPUT Operation

5-53. Numerous test points have been established in the signal generators and are identified by a circle-star designator on Figures 7-4 and 7-5. The dc voltages listed with the test-point designators were obtained with the instrument in an INT 1000 ~ mode of operation.

5-54. ISOLATING TROUBLE IN TRANSISTOR CIRCUITS.

5-55. The following procedures and data are given to aid in determining whether a transistor is operational. Tests are given for both in-circuit and out-of-circuit transistors.

5-56. IN-CIRCUIT TESTING. The common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing the most important consideration is the transistor base-emitter junction. Like the control grid of a vacuum tube, this is the operational control point in the transistor. This junction is essentially a solid-state diode. For the transistor to conduct, the diode must conduct; that is, the diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the function. Use the transistor symbol on the schematic diagram to determine the bias polarity required to forward-bias the base-emitter junction. The A part of Figure 5-22 shows transistor symbols with terminals labeled. Notice that the emitter arrow conventionally points toward the type N material. The other two columns of the illustration compare the biasing required to cause conduction and cut-off in transistors and vacuum tubes. If the transistor base-emitter diode (junction) is forward-biased the transistor conducts. If the diode is heavily forward-biased, the transistor saturates. However, if the base-emitter diode is reverse-biased the transistor is cut-off. The voltage drop across a forward biased emitter-base diode varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2 - 0.3 volt when collector current is 1 - 10 mA, and 0.4-0.5 volt when collector current is 10 - 100 mA. In contrast, forward bias voltage for silicon transistors is about twice that for germanium types: about 0.5 - 0.6 volt when collector current is low, and about 0.8 - 0.9 volt when collector current is high.

5-57. Figure 5-22, part B, shows simplified versions of the three basic transistor circuits and gives the operating characteristics of each. When examining a transistor stage, first determine if the emitter-base diode is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base: there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure to a common point (e.g., chassis). If the emitter-base diode is forward-biased, check for amplifier action by short-circuiting base to emitter while observing collector voltage. The short-circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then shift to near the supply voltage. Any difference is due to leakage current through the transistor and, in general, the smaller this current, the better the transistor. If collector voltage does not change, the transistor may have either an emitter-collector short circuit of emitter-base open circuit.

5-58. TESTING TRANSISTORS WITH AN OHMMETER. The two common causes of transistor failure are internal short- and open-circuits. Remove the transistor from the circuit and use an ohmmeter to measure internal resistance. See Table 5-3 for measurement data.

CAUTION

Most ohmmeters can supply enough current or voltage to damage a transistor. Before using an ohmmeter to measure transistor forward or reverse resistance, check open-circuit voltage and short-circuit current output ON THE RANGE TO BE USED. Open-circuit voltage must not exceed 1.5 volts and short-circuit current must be less than 3 ma. See Table 5-4 for safe resistance ranges for some common ohmmeters.

5-59. REPLACEMENT AND REPAIR.

5-60. The following procedures contain instructions for work on etched circuit boards, replacement of electron tubes, attenuator probe replacement and repair, replacement of Lamp DS1, and diagrams for locating parts in the signal generator.

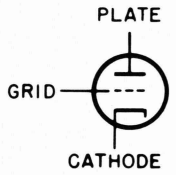
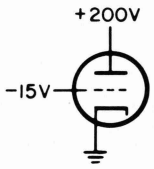
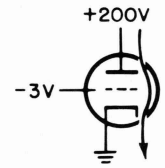
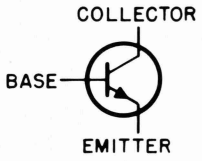
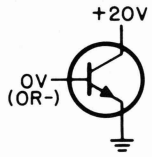
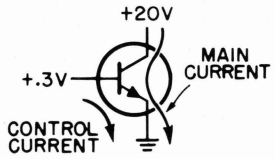
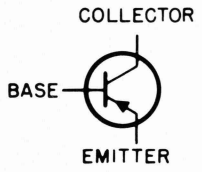
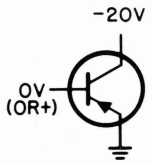
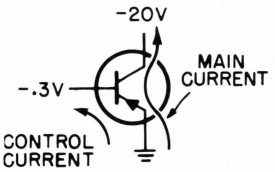
5-61. ETCHED CIRCUIT BOARD REPAIR.

5-62. The etched circuit boards in the Signal Generator are of the plated-through type consisting of metallic conductors bonded to both sides of insulating material. The metallic conductors are extended through the component mounting holes by a plating process. Soldering can be done from either side of the board with equally good results. Table 5-5 lists recommended tools and materials. Following are recommendations and precautions pertinent to etched circuit repair work.

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

A. TRANSISTOR BIASING

DEVICE	SYMBOL	CUT OFF	CONDUCTING
VACUUM TUBE			
N P N TRANSISTOR			
P N P TRANSISTOR			

B. AMPLIFIER CHARACTERISTICS

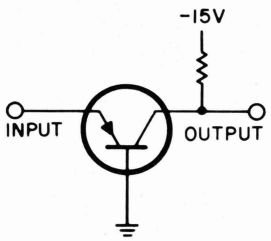
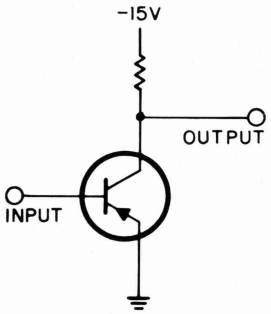
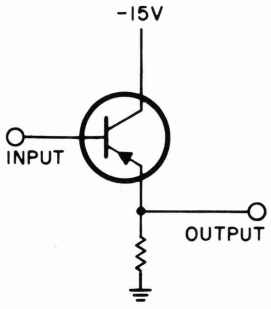
CHARACTERISTIC	COMMON BASE	COMMON EMITTER	COMMON COLLECTOR
INPUT Z	30-50 Ω	500-1500 Ω	20-500K Ω
OUTPUT Z	300-500K Ω	30-50K Ω	50-1000 Ω
VOLTAGE GAIN	500-1500	300-1000	< 1
CURRENT GAIN	< 1	25-50	25-50
POWER GAIN	20-30 dB	25-40 dB	10-20 dB
			

Figure 5-22. Transistor Biasing and Operating Characteristics

Table 5-3. Out-of-Circuit Transistor Resistance Measurement

Transistor Type		Connect Ohmmeter Pos. lead to	Connect Ohmmeter Neg. lead to	Measure Resistance (ohms)
PNP Germanium	Small Signal	emitter	base*	200 - 500
		emitter	collector	10K - 100K
	Power	emitter	base*	30 - 50
		emitter	collector	several hundred
NPN Silicon	Small Signal	base*	emitter	1K - 3K
		collector	emitter	very high (might read open)
	Power	base	emitter	200 - 1000
		collector	emitter	high, often greater than 1 M

*To test for transistor action, add collector-base short. Measured resistance should decrease.

c. Use a suction device (see Table 5-5) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion. See Table 5-5 for recommendations.

5-63. COMPONENT REPLACEMENT.

a. Remove defective component from circuit board.

b. Remove solder from mounting holes using a suction desoldering aid (Table 5-5) or wooden toothpick.

c. Shape leads of replacement component to match mounting hold spacing.

d. Insert component leads into mounting holes, and position component as original was positioned. DO NOT FORCE LEADS OF REPLACEMENT COMPONENT INTO MOUNTING HOLES. Sharp leads ends may damage plated-through conductor.

NOTE

Axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection, and clip off excess lead.

5-64. ETCHED CONDUCTOR REPAIR.

5-65. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlap and remove any varnish from etched conductor before soldering wire into place.

Table 5-4. Safe Ohmmeter Ranges for Transistor Resistance Measurements

Ohmmeter	Safe Range(s)	Open Ckt Voltage	Short Ckt Current	Lead Color	Lead Polarity
412A	R x 1K	1.0V	1 mA	Red	+
	R x 10K	1.0V	100 μA	Blk	-
	R x 100K	1.0V	10 μA		
	R x 1M	1.0V	1 μA		
	R x 10M	1.0V	0.1 μA		
410C	R x 1K	1.3V	0.57mA	Red	+
	R x 10K	1.3V	57 μA	Blk	-
	R x 100K	1.3V	5.7 μA		
	R x 1M	1.3V	0.5 μA		
	R x 10M	1.3V	0.05μA		
410B	R x 100	1.1V	1.1 mA	Blk	+
	R x 1K	1.1V	110 μA	Red	-
	R x 10K	1.1V	11 μA		
	R x 100K	1.1V	1.1 μA		
	R x 1M	1.1V	0.11μA		
Simpson 260	R x 100	1.5V	1 mA	Red	+
				Blk	-
Simpson 269	R x 1K	1.5V	0.82 mA	Blk	+
				Red	-
Triplett 630	R x 100	1.5V	3.25 mA	Varies with Serial Number	
	R x 1K	1.5V	325 μA		
Triplett 310	R x 10	1.5V	750 μA		
	R x 100	1.5V	75 μA		

Table 5-5. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering Tool	Soldering Unsoldering	Wattage rating: 37.5 Tip Temp: 750-800°F Tip Size: 1/8" OD	Ungar #776 Handle with Ungar #1237 Heating Unit
Soldering Tip	Soldering	Shape: chisel	Ungar #PL113
General Purpose	Unsoldering	Size: 1/8"	
De-soldering aid	Unsoldering multi-connection components (e.g., tube sockets	Suction device to remove molten solder from connection	Soldapult by the Edsyn Company, Arleta, California
Resin (flux) solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Acetone Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination, corrosion protection after soldering	Good electrical insulation, corrosion-prevention properties	Krylon #1302* Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp. Woodside 77, New York
*Krylon, Inc., Norristown, Pennsylvania			

5-66. TRANSISTOR AND SEMICONDUCTOR DIODE REPLACEMENT.

a. Do not apply excessive heat. See Table 5-5 for soldering tool specifications.

b. Use a heat sink, such as pliers, between semiconductor body and hot soldering iron.

c. When installing a replacement semiconductor ensure sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as used for original semiconductor.

d. Refer to Table 5-6 for checks following replacement of a semiconductor.

5-67. REPLACEMENT OF ELECTRON TUBES.

5-68. When replacing tubes in the Model 608E/F, it is recommended that a check be made of the operation of the instrument before and after each tube trial and, if no improvement is noted, the original tube be returned to the socket. Figure 5-23 locates all electron tubes in the equipment. Table 5-6 lists all tubes, together with the checks which should be made following tube replacement.

5-69. OSCILLATOR TUBE REPLACEMENT. Replacement of RF Oscillator tube V6 may affect the calibration of the frequency dial and the amplitude of the RF Generator heater-voltage supply. In addition,

Table 5-6. Checks Following Tube and Semiconductor Replacement

Reference Designation	Check	Paragraph
V2	Internal Modulation	5-22
V6	Frequency Accuracy	5-12
	Frequency Drift	5-14
V8	Maximum RF Output	5-17
	Uncalibrated RF Output	5-20
V9	Calibrator Accuracy	5-13
V10	Calibrator Accuracy	5-13
V11	Calibrator Accuracy	5-13
V12	Power Supply (+225)	5-31
V13	Power Supply (+225)	5-31
V14	Power Supply (-165)	5-31
V15	Power Supply (-165)	5-31
V16	Power Supply (-165)	5-31
V18	Modulation Meter Accuracy	5-21
V19	Modulation Meter Accuracy	5-21
V20	Modulation Meter Accuracy	5-21
V21	Modulation Meter Accuracy	5-21
V22	Maximum RF Output	5-17
Q1	Power Supply	5-31
Q2	Leveling	5-18
Q3	Leveling	5-18
	Internal Modulation	5-22
Q4	Leveling	5-18
	Internal Modulation	5-22
Q5	Leveling	5-18
	External Pulse Modulation	5-24
Q6	Leveling	5-18
	Internal Modulation	5-22
Q7	Leveling	5-18
	Internal Modulation	5-22
Q8	Leveling	5-18
	Internal Modulation	5-22
Q9	Leveling	5-18
	Internal Modulation	5-22
Q10	Power Supply (+25)	5-31
Q11	Power Supply (+25)	5-31
CR1	Crystal Calibrator Accuracy	5-13
CR2	Modulation Meter Accuracy	5-21
CR7	Leveling	5-18
CR8	Power Supply (+225)	5-31
CR9	Power Supply (+225)	5-31
CR10	Power Supply (+225)	5-31
CR11	Power Supply (+225)	5-31
CR12	Power Supply (-165)	5-31
CR13	Power Supply (-165)	5-31
CR14	Power Supply (-165)	5-31
CR15	Power Supply (-165)	5-31
CR16	Power Supply (-6.3)	5-31
CR17	Power Supply (-6.3)	5-31
CR18	Power Supply (-6.3)	5-31
CR19	Power Supply (-6.3)	5-31
CR20	Power Supply (-6.3)	5-31
CR21	Leveling	5-18
CR23	External Pulse Modulation	5-24
CR24	External Pulse Modulation	5-24
CR25	Leveling	5-18
CR26	Leveling	5-18
CR27	Power Supply (+25)	5-31
CR28	Power Supply (+25)	5-31
CR29	Power Supply (+25)	5-31
CR30	Power Supply (+25)	5-31

plate current requirements of type 4042 pencil triodes may differ widely from tube to tube in a given application. Therefore, when V6 is replaced, heater voltage must be checked and, if necessary, reset to the proper value; plate current must be held to between 18 and 27 milliamperes by tube selection; and calibration of the frequency dial must be checked.

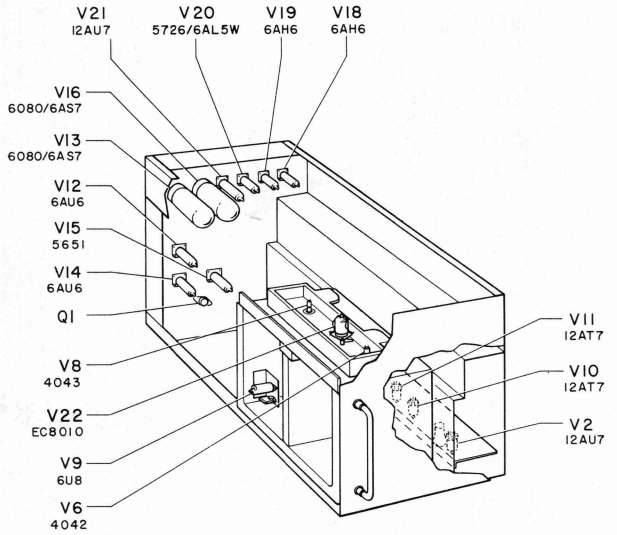


Figure 5-23. Location of Electron Tubes

5-70. To replace Oscillator V6, refer to Figure 5-24 and proceed as follows:

a. Remove frequency dial and top plate from RF Generator housing to gain access to tube compartment. (The frequency dial is accurately indexed on its hub by two pins to assure exact positioning when dial is replaced on hub.)

b. Remove socket from base of V6 by straight pull.

c. Remove cathode clip from tube.

d. Remove the two BH screws holding retainer plate, then remove plate and fiber spacer.

e. Lift tube gently from hole by straight pull.

f. Replace tube in reverse order of above steps.

g. Connect a dc voltmeter to inside lead of FL4. Meter should indicate 6.3 Vdc. If necessary, change value of CR20 to obtain 6.3 Vdc.

h. Using Model 428 DC Ammeter, measure current in lead to feed-through capacitor C15.

i. Set the FREQUENCY RANGE switch to band E. Current meter should indicate between 18 and 27 mA.

If meter indication is not within these limits, substitute another 4042 oscillator tube.

j. Using internal beat-frequency calibrator, check frequency calibration throughout range of signal generator, noting points that are significantly off frequency.

k. To correct calibration at the high-frequency end of all bands simultaneously, adjust trimmer capacitor C18 in the 608E, and C59 in the 608F, which is accessible in tube compartment in RF Generator housing. This adjustment has only minor effect at low-frequency ends of all ranges.

5-71. RF AMPLIFIER AND BUFFER TUBE REPLACEMENT. To remove RF Amplifier V8 and Buffer V22, refer to Figure 5-24 and proceed as follows:

NOTE

Replacement of the RF Amplifier and Buffer tubes can affect the amplitude of the RF generator heater-voltage supply and may limit the power output from the signal generator.

a. Remove frequency dial and top plate from RF Generator housing to gain access to tube compartment.

b. Replace Buffer V22.

c. For Amplifier V8, remove socket from base of V8 by straight pull.

d. Remove cathode clip from tube.

e. Using special wrench (located on instrument chassis, near RF Generator housing), loosen threaded retainer ring which holds V8 in housing. Remove retainer ring and neoprene washer.

f. Remove old tube and replace with new type 4043 tube.

g. Check power output throughout full frequency range of signal generator. With AMPL TRIMMER set for maximum output at each frequency, a full-scale reading should be obtained over entire frequency range.

5-72. CRYSTAL OSCILLATOR TUBE OR QUARTZ CRYSTAL REPLACEMENT. To gain access to the Calibrator Oscillator, remove the side cover on the RF Generator housing. The entire Crystal Oscillator is mounted on a bracket on the rear wall of the amplifier compartment. Location of oscillator tube V9, crystal Y1, and associated adjustments are shown in Figure 5-27. If V9 or Y1 is replaced, the calibrator should be checked and, if necessary, adjusted.

5-73. The crystal-controlled frequency calibrator is composed of two circuits: the 5-MHz crystal-controlled oscillator, which utilizes the pentode half of a type 6U8 tube, and the 1-MHz oscillator, utilizing the triode section of the 6U8. Each section is adjustable, and both sections should be adjusted at the same time. The frequency of the crystal can only be adjusted over a range of approximately 100 Hz. The frequency of the 1-MHz oscillator then locks in with the 5-MHz frequency and is either right on frequency or is very far off. To adjust the crystal-controlled calibrator, refer to paragraph 5-47.

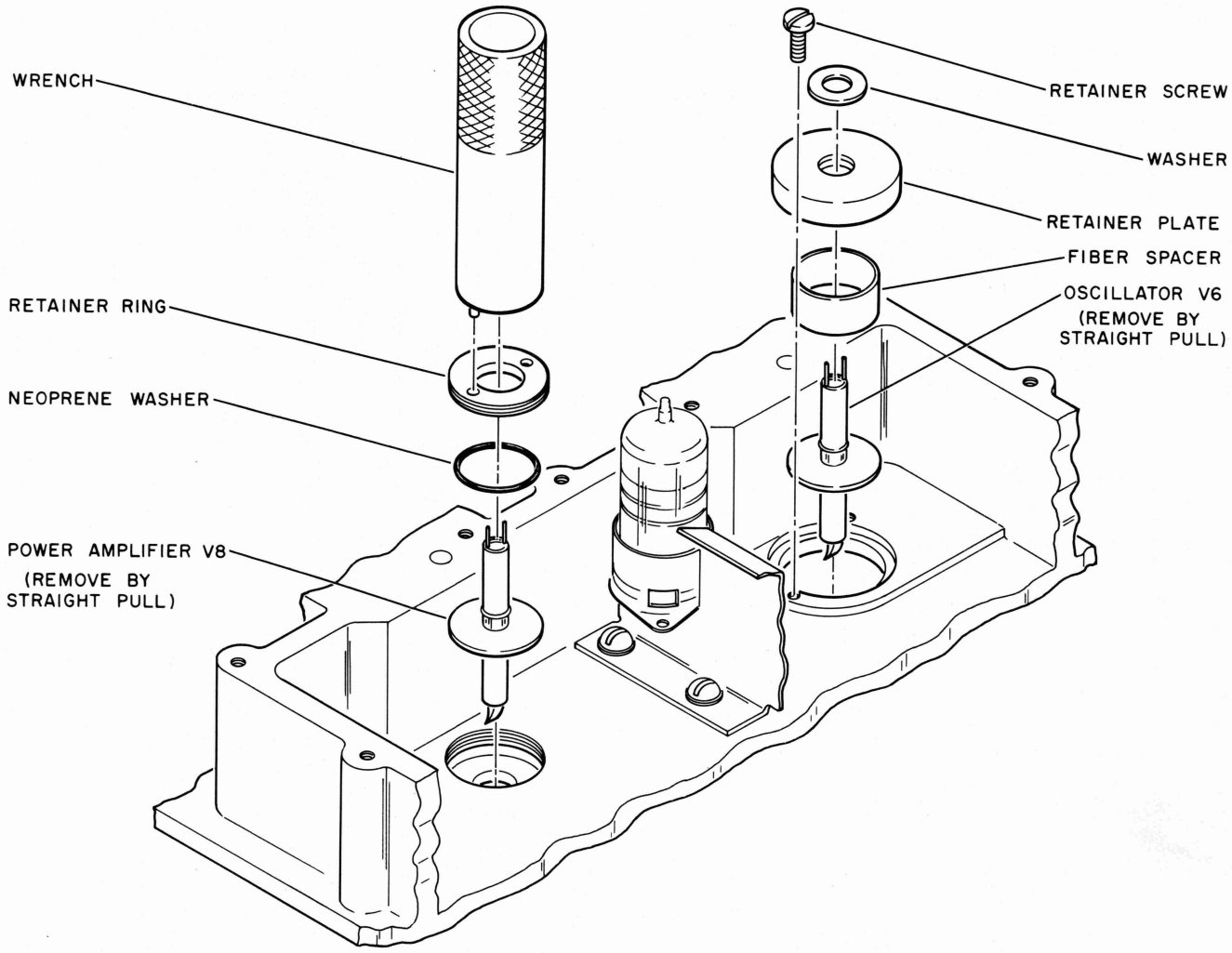


Figure 5-24. Replacement of Oscillator and Amplifier Tubes

5-74. ATTENUATOR PROBE REPAIR AND REPLACEMENT.

CAUTION

During removal and replacement of the probe, extreme care must be exercised. The probe consists of a cylindrical metal tube with a series of spring contact fingers around its periphery at one end. These fingers can be accidentally bent or twisted. It should be noted that one or two of the fingers are bent toward the center of the probe slightly; do not attempt to straighten them, since these fingers have been bent to assure clearance between the probe and the end of the guide slot in the attenuator housing. It is of greatest importance to make certain that the probe is not subjected to shock. If subjected to shock, the electrical components attached to the end of the probe can be broken or their positions altered, with a consequent change in the electrical characteristics of the probe.

5-75. GENERAL. The impedance-matching network in the output attenuator can be damaged if power from an external source is applied to the RF OUTPUT connector. If electrical components of the output attenuator are damaged, repair or replacement is necessary. Damage to the impedance-matching network may be confirmed by measuring the VSWR of the attenuator at the RF OUTPUT connector.

NOTE

Attenuator VSWR is determined by positioning of the probe variable capacitor (C37) and the relative position of the two resistors (R58 and R59) on the end of the probe. If replacement resistors are returned to their original positions, the VSWR will not be changed appreciably. However, if equipment is available for checking attenuator VSWR, such a check is advisable following replacement of resistors.

5-76. REMOVAL FROM HOUSING. If investigation shows an attenuator to be defective, proceed as follows:

a. Turn attenuator control on front panel until probe reaches end of its travel at rear of attenuator housing.

b. Remove nut and washers that hold drive cable in probe drive screw (Figure 5-25) in top of attenuator probe.

c. Remove probe split drive screw from probe body by removing inner nut and unscrewing.

d. Remove probe by carefully sliding it out of attenuator housing.

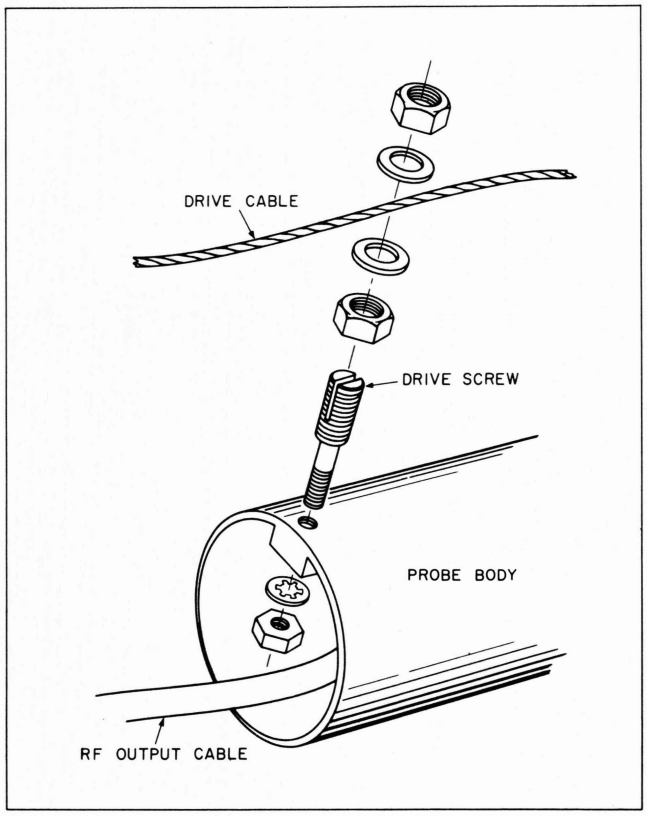


Figure 5-25. Disassembly of Attenuator Drive Cable

5-77. PROBE REPAIR. Capacitor C69 (Figure 5-26) is held in place by a mounting strap and a setscrew. To replace C69, unsolder the pickup loop at the capacitor end (ground slide of loop), loosen the setscrew, and slide the capacitor out of the clamp. Replace by reversing this procedure. The capacitor must be firmly seated in the hole in the end of the probe before tightening the setscrew. Be careful when tightening the setscrew; the capacitor ground lead can be cut in two if the setscrew is tightened excessively.

5-78. Note location of the two resistors so that new ones can be mounted as nearly as possible in the same position. Install new resistors; duplicate the original resistor mounting positions and lead lengths as closely as possible. Make connections without excessive binding or pulling on ends of resistors as they are fragile.

CAUTION

These resistors are easily damaged by excessive heat. Use low-temperature soldering iron and solder connections as quickly as possible.

5-79. Measure resistors for any possible change in resistance due to soldering. The VSWR will not be changed appreciably.

5-80. The VSWR can be checked at several frequencies on band E, and the position of resistors R59 and R58 adjusted for optimum VSWR. Adjustment on the band E will automatically correct for minimum VSWR on the lower bands. Laboratory test equipment, such as an impedance bridge or reflectometer setup, will be required for measuring the VSWR. These VSWR checks must be made with attenuator inserted in attenuator housing in the instrument, as results obtained will be slightly different with attenuator outside of the housing.

5-81. PROBE REPLACEMENT. If repair is not possible, both probe and cable must be replaced. Remove the RF OUTPUT connector from the front panel, and release the cable from the clamp holding the cable to the top of the side gusset. The entire probe assembly may then be removed from the instrument. Replacement probes are complete with cable and panel connector; and require no adjustment of the impedance-matching network upon installation.

5-82. REPLACEMENT IN HOUSING.

a. Insert new or repaired probe in attenuator housing. Care must be taken in starting probe into housing, since diameter at probe contact fingers is slightly greater than inner diameter of housing. Contact fingers should be depressed slightly while starting probe into its housing.

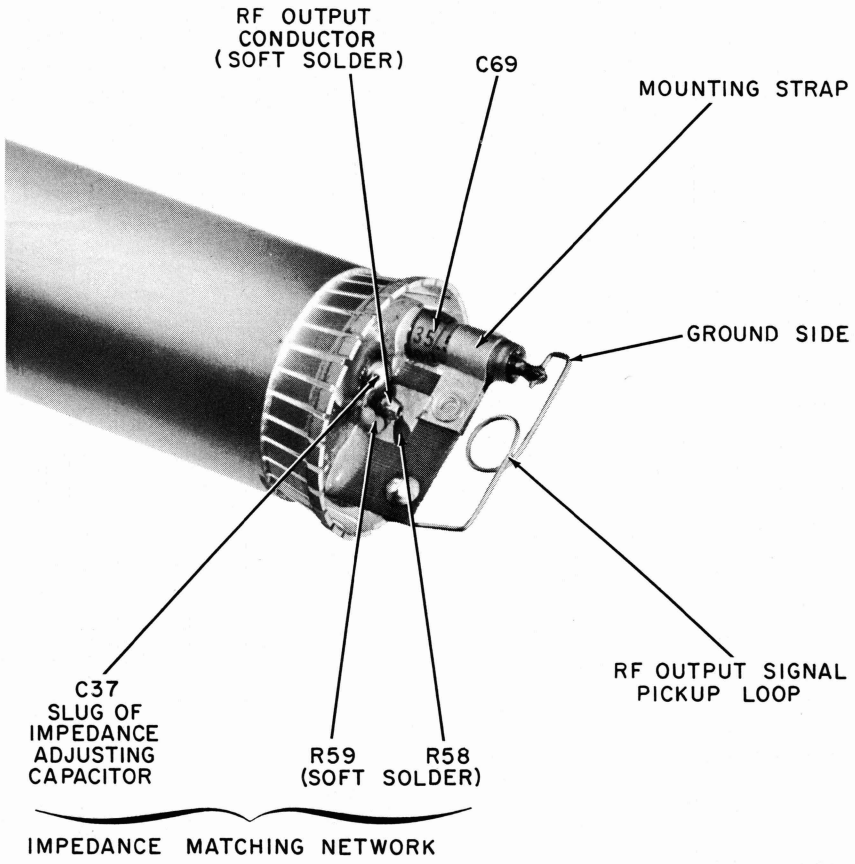


Figure 5-26. Attenuator Probe, Showing Pickup Loop and Impedance Matching Network

CAUTION

Under no circumstances should the probe be forced into the housing.

b. Replace split drive screw in probe, making certain that screw slot is parallel to axis of housing.

c. Set attenuator drive cable in screw slot and replace both washers and nut. Do not tighten nut. Cable must move freely through the slot until probe penetration has been set.

d. Secure RF cable to clamp on side gusset.

e. Connect instrument to a source of 115-volt for 230 volt) power, and turn on POWER switch. Unless otherwise specified, operating controls should be set as follows:

MODULATION Selector	CW
Frequency dial	70 MHz
FREQUENCY RANGE	band C
AMPL TRIMMER	Adjust for max. RF output
RF OUTPUT meter	7 dBm
MODULATION control	max. ccw
Attenuator	0 dBm

f. Connect a power meter (such as Model 432A), through a thermistor mount (Model 478A or equivalent), to RF OUTPUT connector.

g. Remove RF Generator side plate so that clearance between attenuator probe and coils of RF Amplifier tank may be observed.

CAUTION

The following step must be executed as carefully as possible to insure that the pickup loop does not make contact with any of the power amplifier coils. These coils are at B+ potential, and contact between any one of them and the attenuator pickup loop will damage attenuator components.

h. With attenuator dial set exactly on 0 dBm, manually advance attenuator probe into the housing until RF output signal is exactly 1 milliwatt (0 dBm) as read on external power meter.

i. Tighten down nut on split drive screw so that probe may be actuated by its drive system. Carefully check to see that there is clearance between various amplifier coils and pickup loop when attenuator dial is set to +7 dBm.

5-83. REPLACEMENT OF LAMP DS1.

5-84. Lamp DS1 acts as a positive temperature coefficient resistance, maintaining Modulator Oscillator output constant. The characteristics of the type S6 lamps used for this purpose ordinarily vary widely from lamp to lamp, causing a corresponding variation in the amplitude of the oscillator output from one Model 608E/F to another. To compensate for differences between lamps, potentiometer R7 is provided for adjustment of the oscillator output voltage level. After lamp I1 has been replaced, the oscillator output voltage, as measured at pin 3 of V2, should be adjusted to 2 volts rms; if it cannot be adjusted to this value, another lamp must be tried.

5-85. LOCATION OF PARTS.

5-86. To enable maintenance personnel to properly identify and locate replacement parts during adjustments, troubleshooting, and repair periods Figures 5-27 through 5-33 are presented at the rear of this section. A parts identification diagram for the ALC board is contained on Figures 7-3, 7-4 and 7-5.

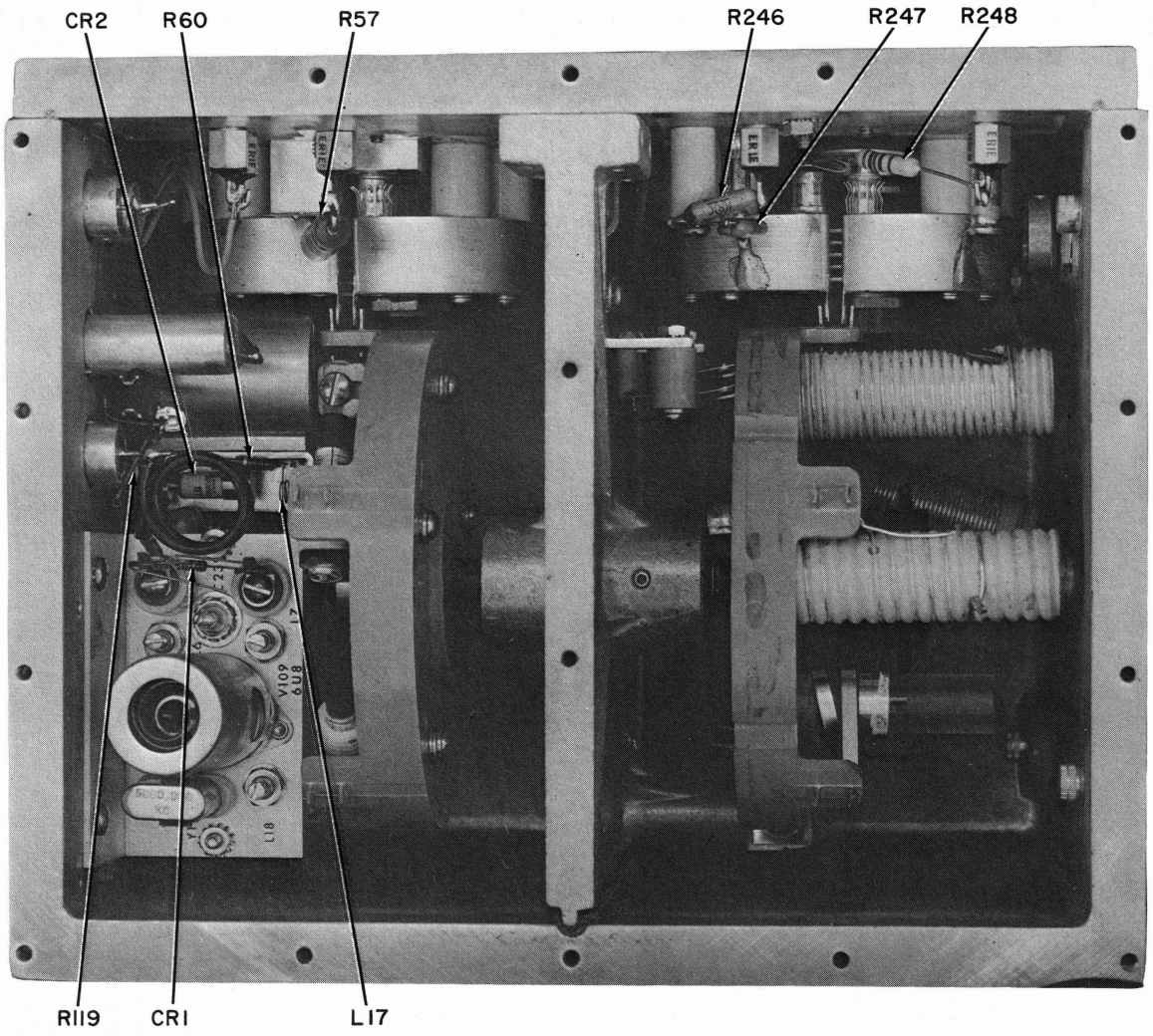


Figure 5-27. RF Generator Assembly Showing Location of Unlabeled Parts (Side Cover Removed)

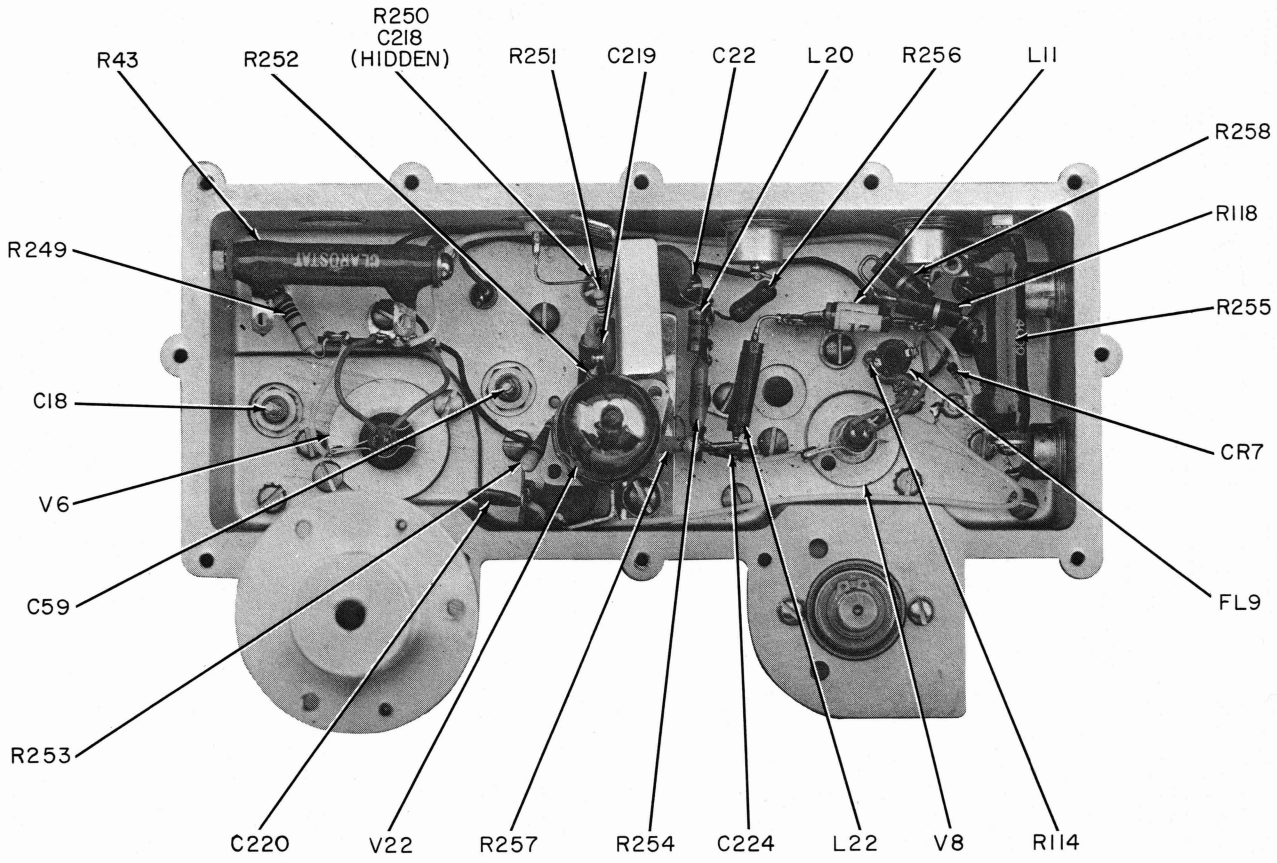


Figure 5-28. Model 608E RF Generator Assembly Showing Location of Unlabeled Parts (Top Cover Removed)

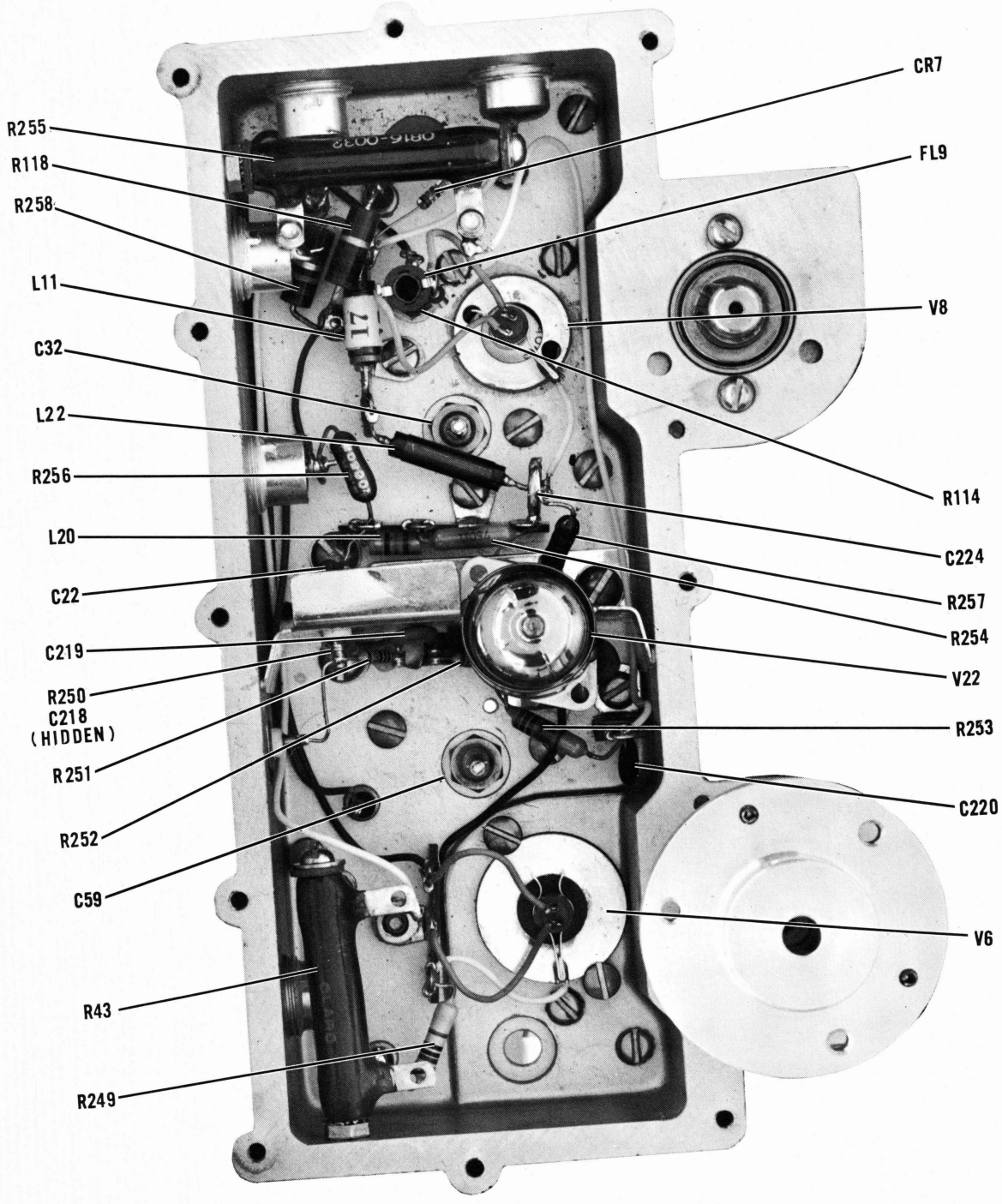


Figure 5-29. Model 608F RF Generator Assembly Showing Location of Unlabeled Parts (Top Cover Removed)

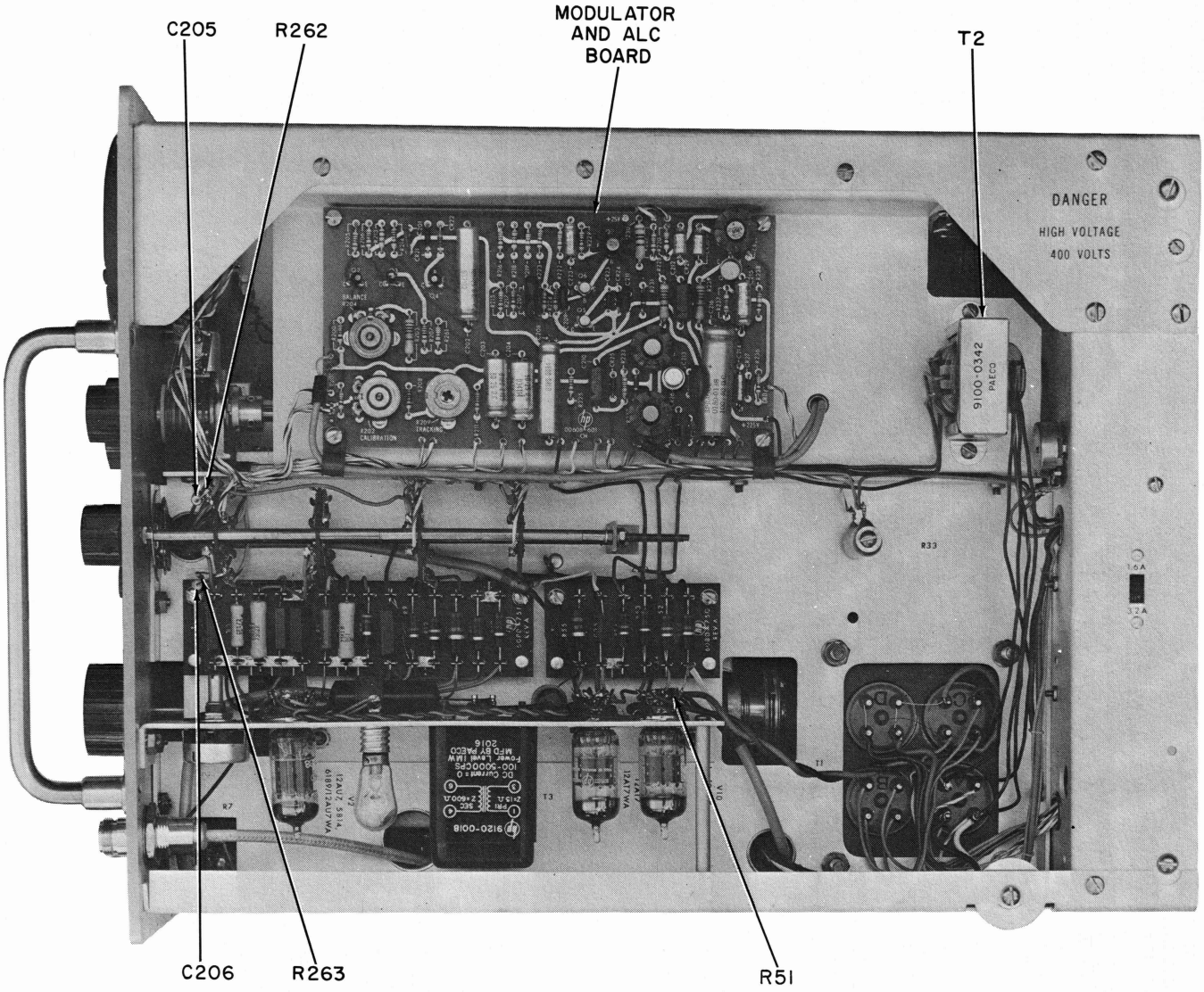


Figure 5-30. Right Side View Showing Location of Unlabeled Chassis Components

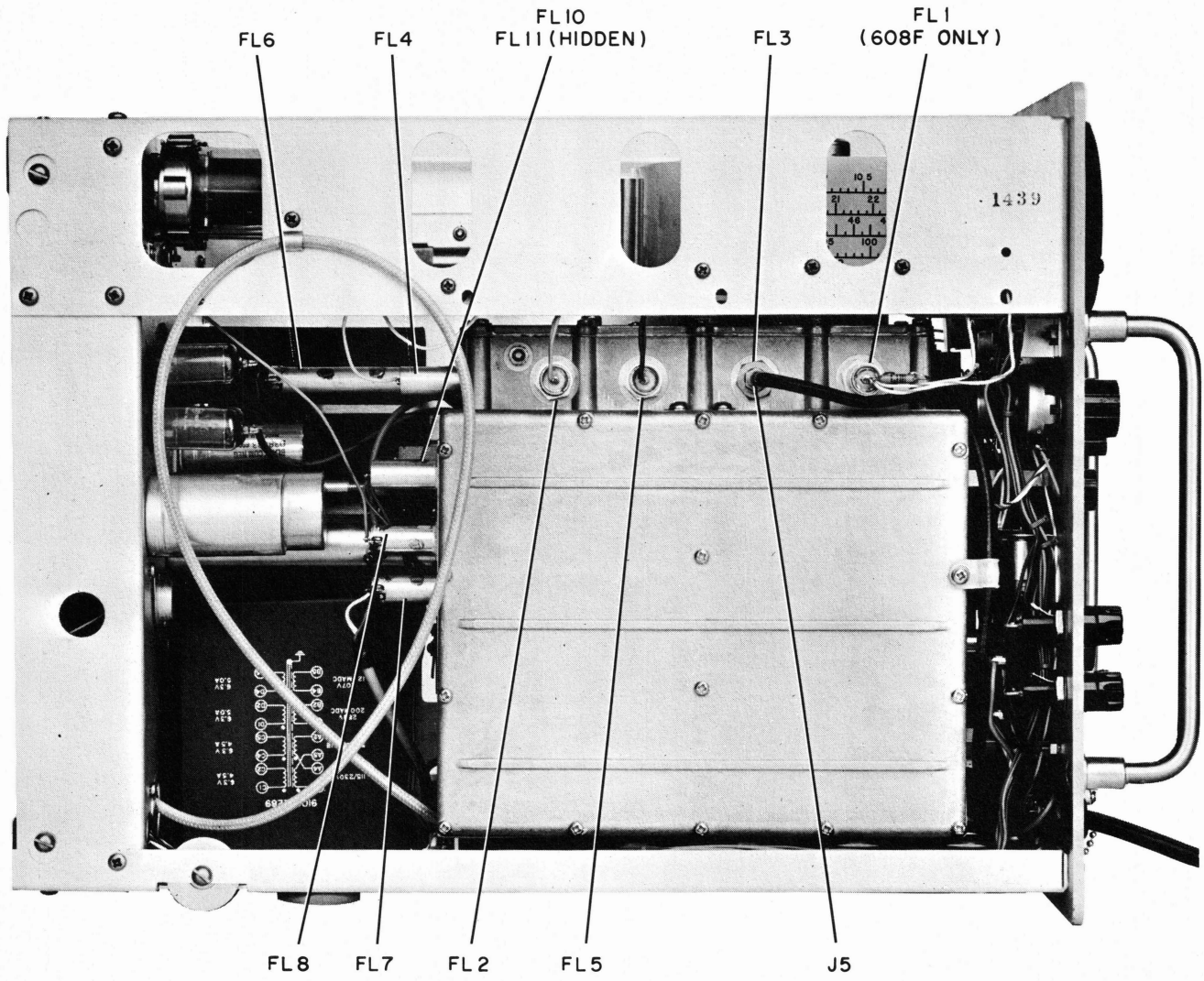


Figure 5-31. Left Side View Showing Location of Unlabeled Components

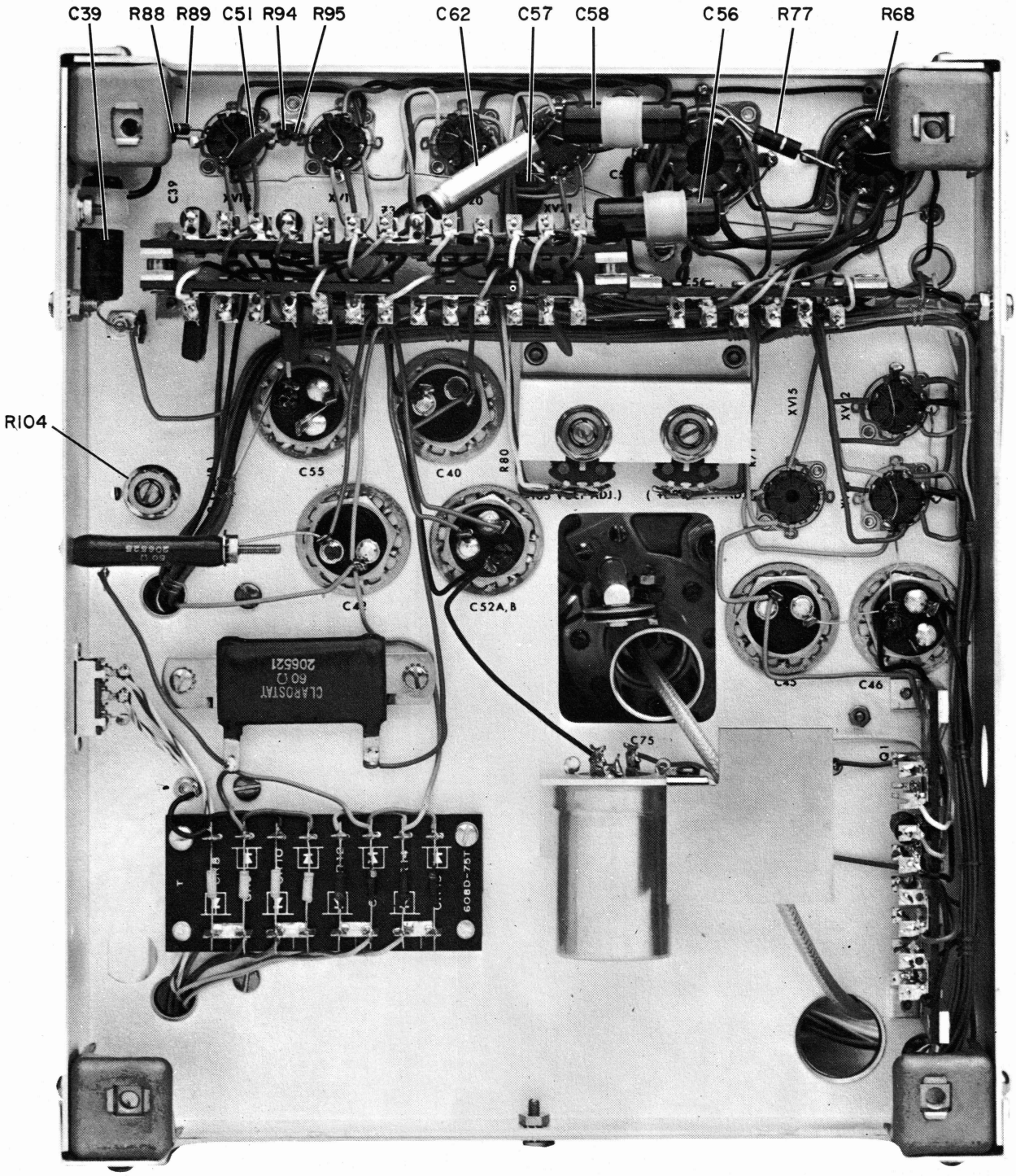
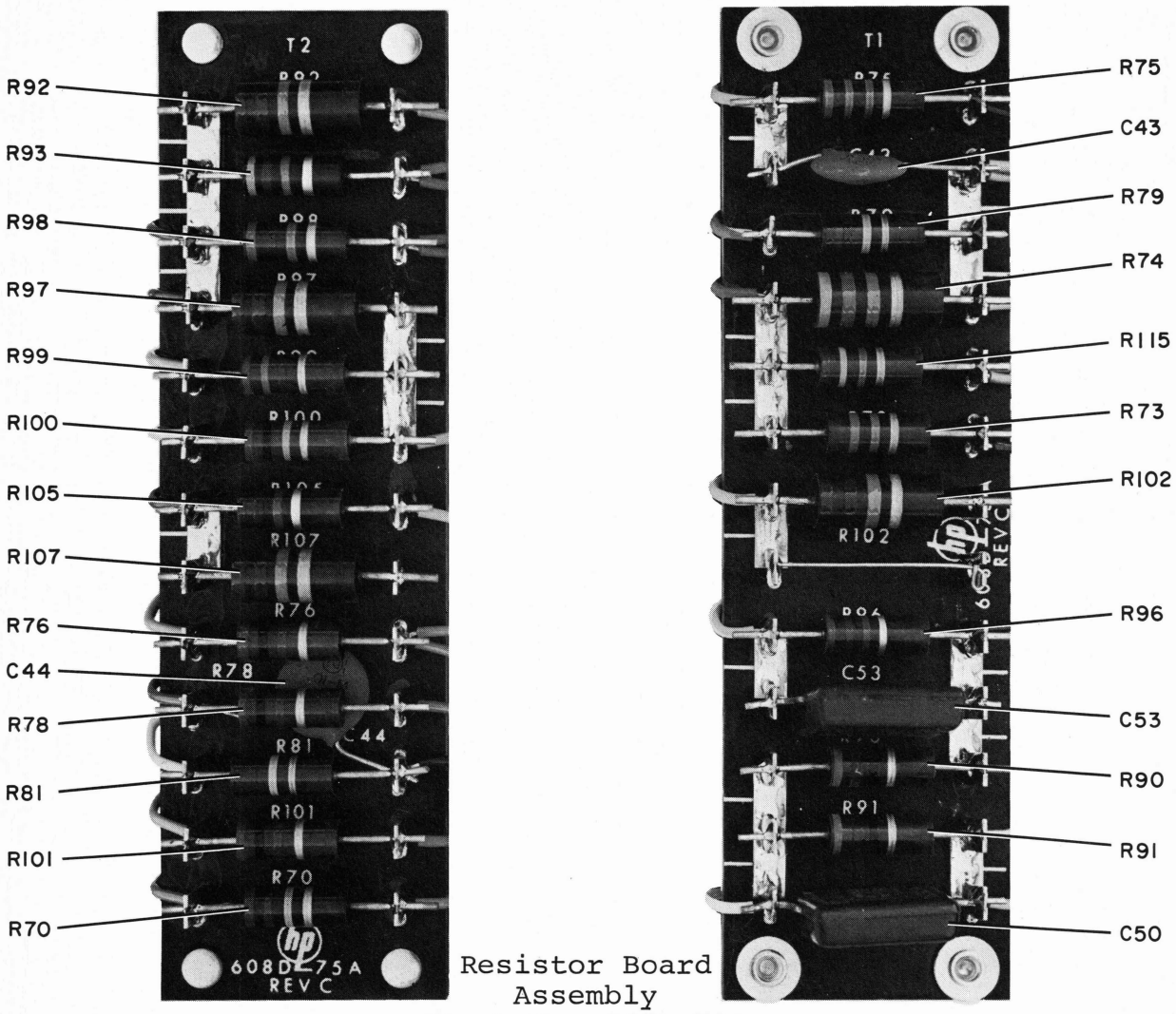
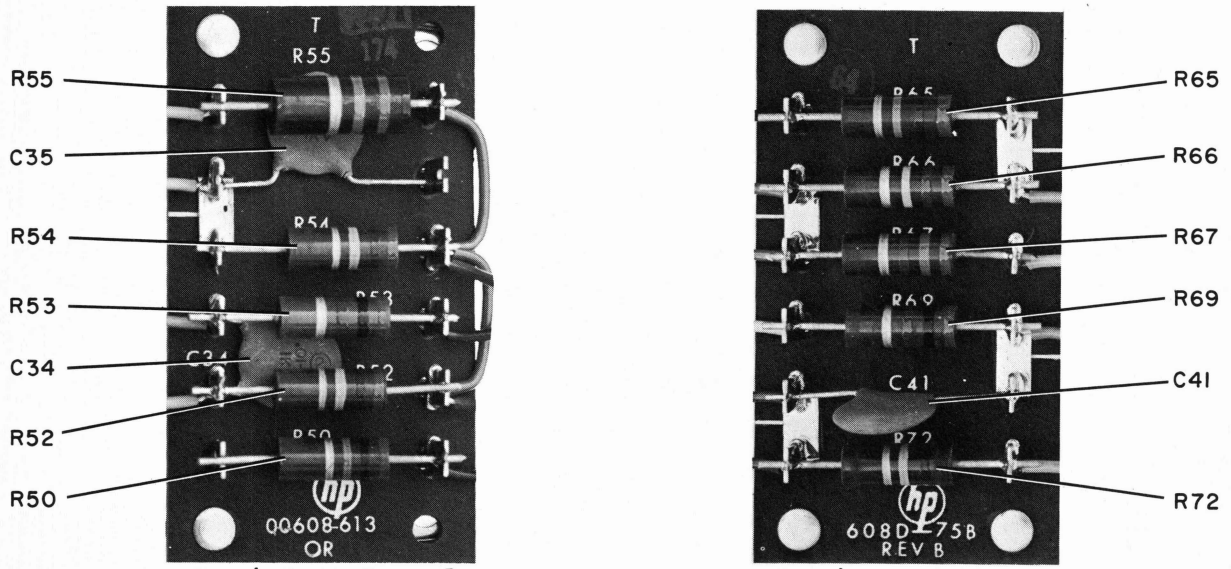


Figure 5-32. Rear View Showing Location of Unlabeled Chassis Components



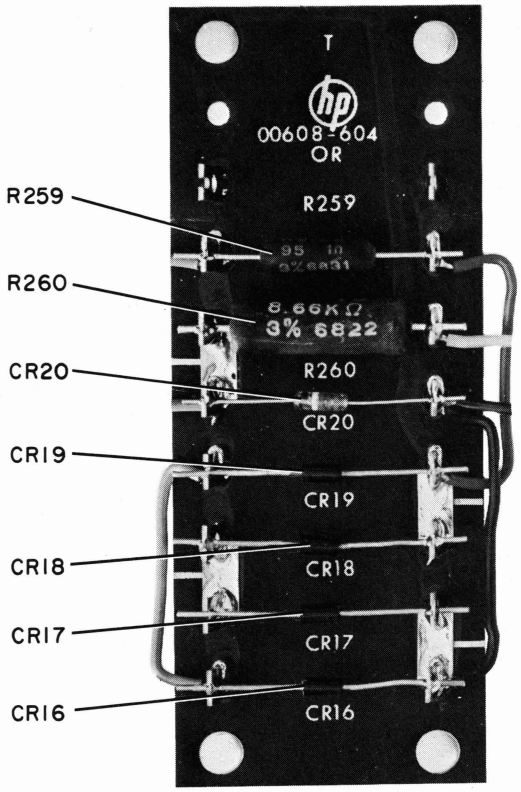
Resistor Board Assembly
Stock No. 608D-75A



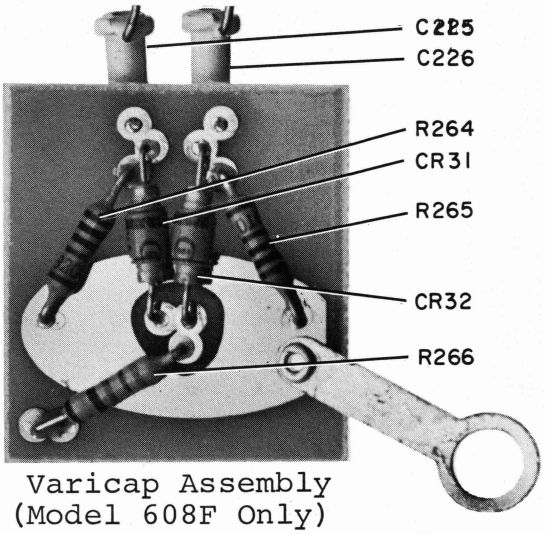
Resistor Board Assembly
Stock No. 00608-613

Resistor Board Assembly
Stock No. 608D-75B

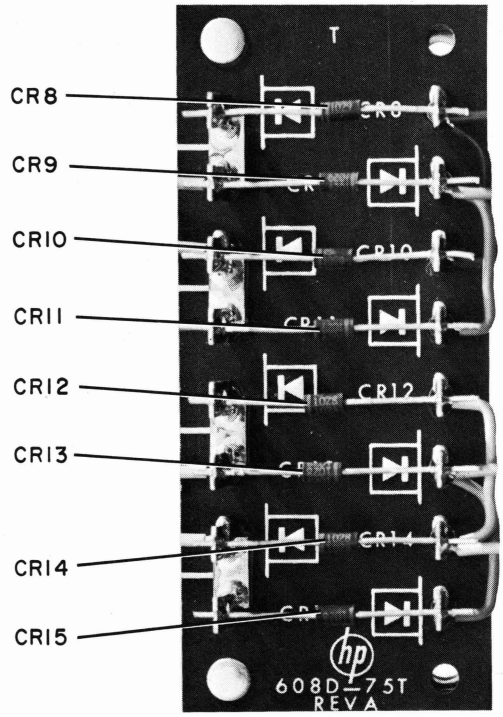
Figure 5-33. Circuit Board Parts Identification
(Sheet 1 of 2)



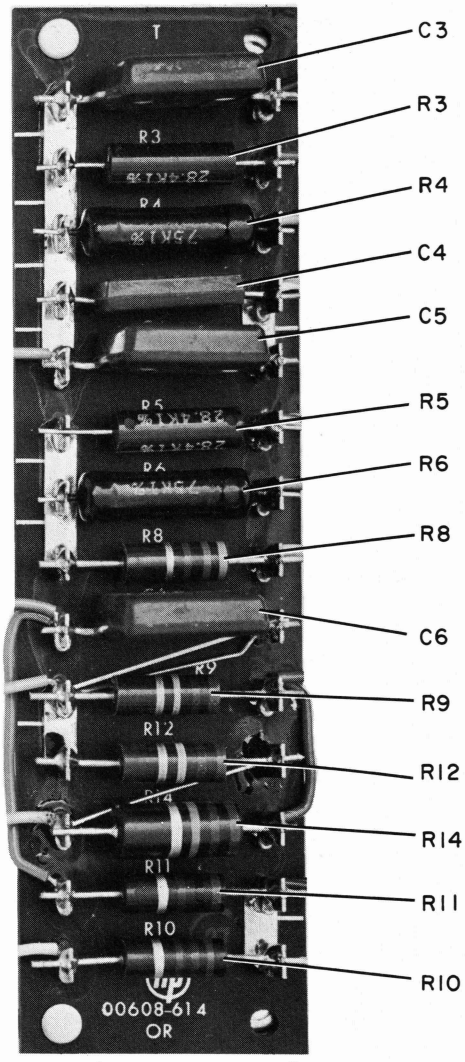
Rectifier-Resistor
Board Assembly
Stock No. 00608-604



Varicap Assembly
(Model 608F Only)
Stock No. 00608-625



Rectifier Board
Assembly
Stock No. 608D-75T



Resistor Board
Assembly
Stock No. 00608-614

Figure 5-33. Circuit Board Parts Identification
(Sheet 2 of 2)

Table 5-7. Model 608E/F Troubleshooting Procedure

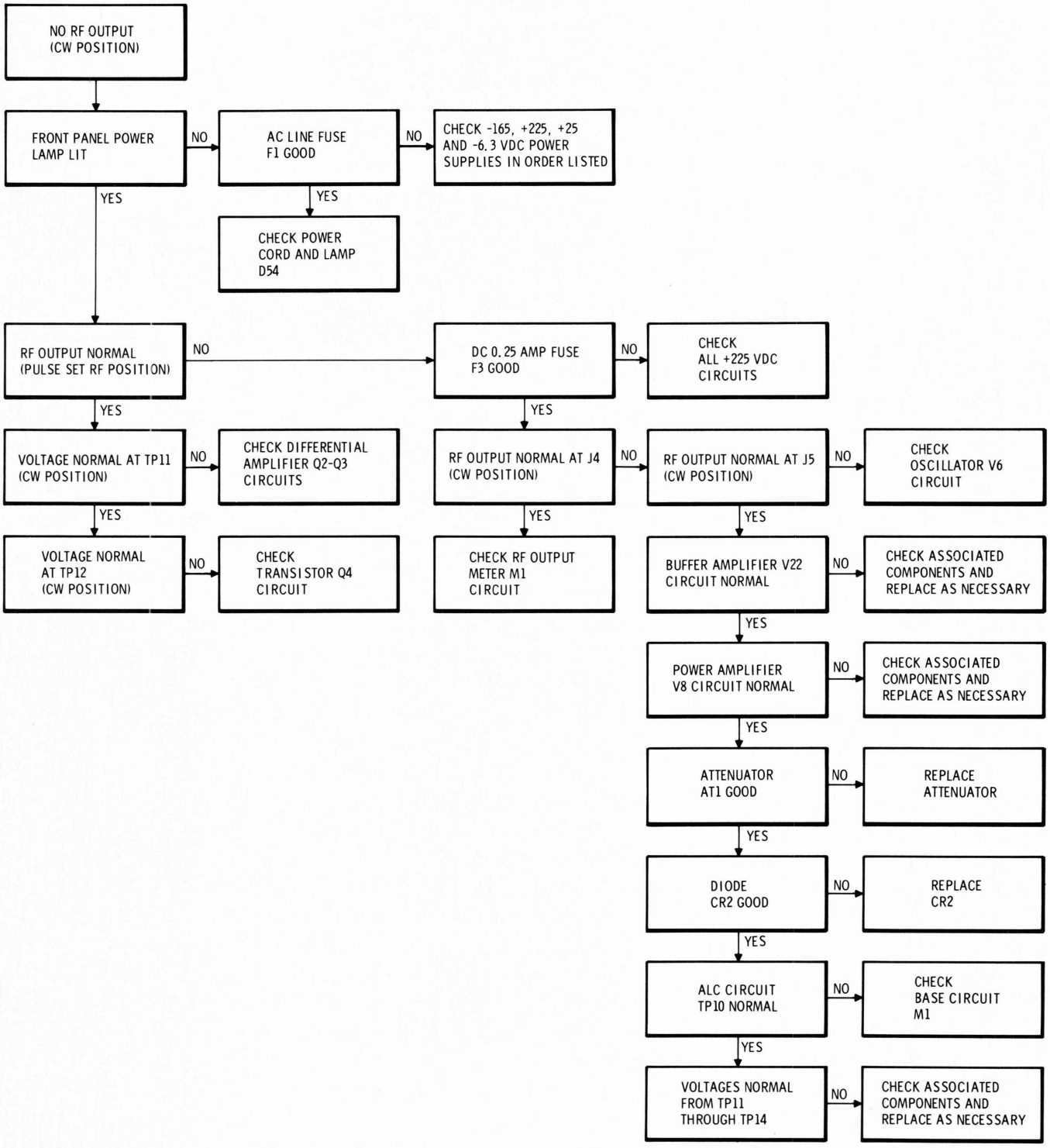
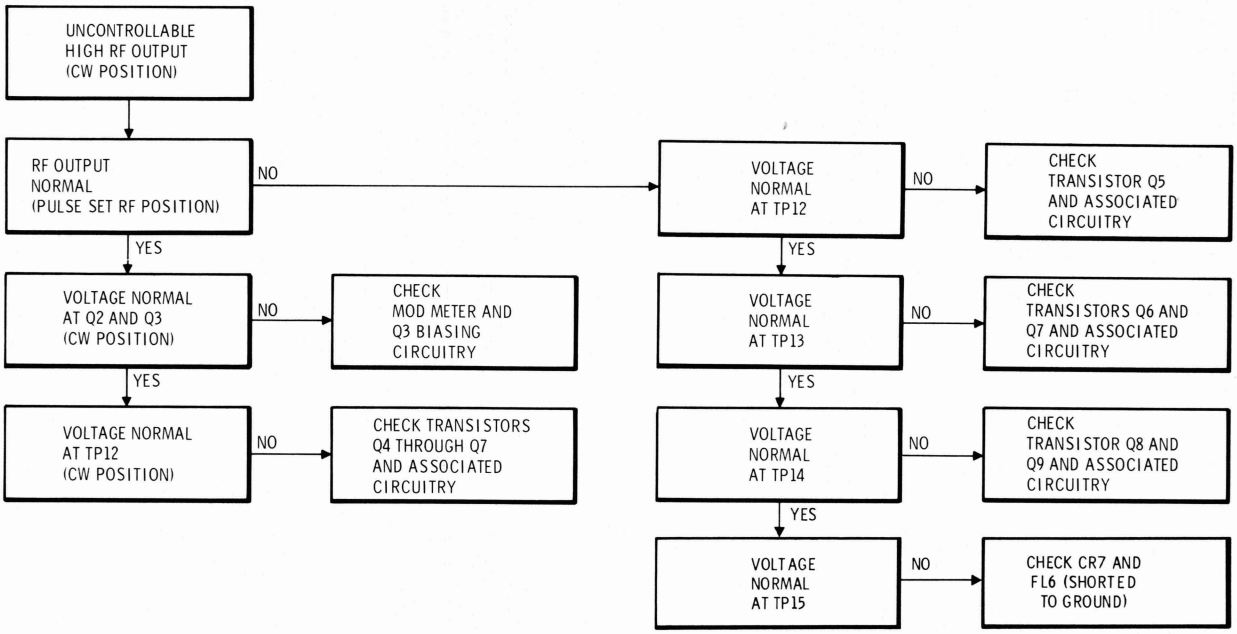


Table 5-7. Model 608E/F Troubleshooting Procedure (Continued)



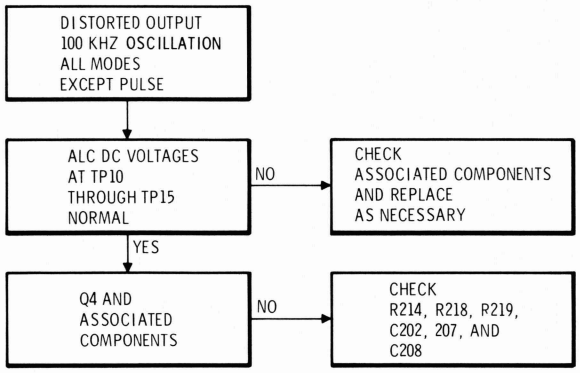
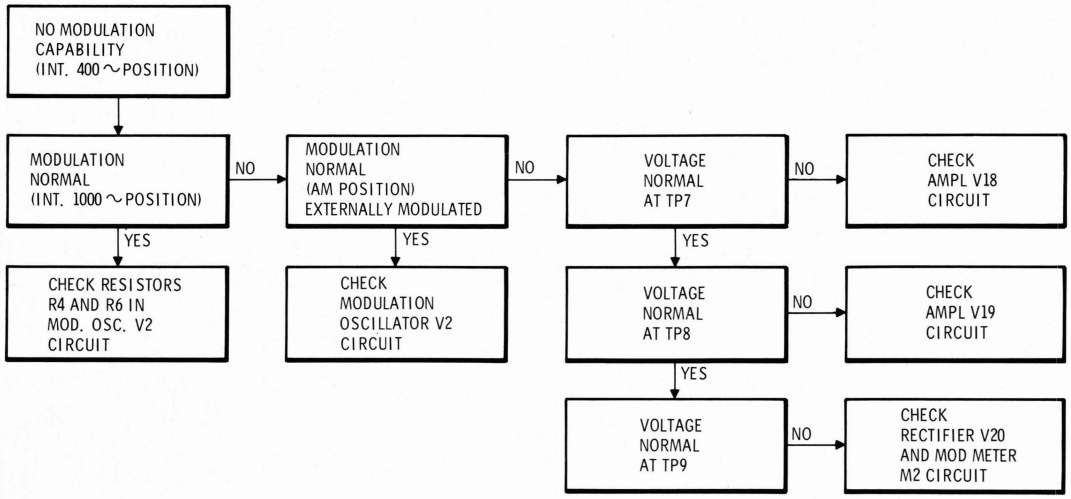
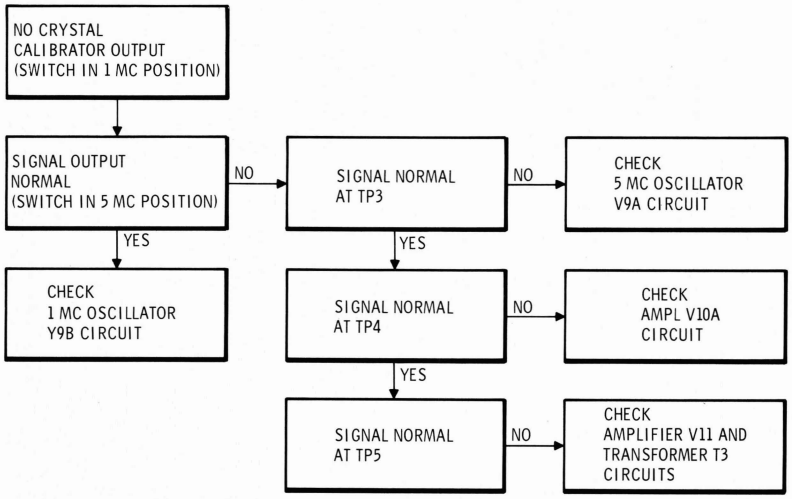

DISTORTED OUTPUT 100 KHZ OSCILLATION ALL MODES EXCEPT PULSE
ALC DC VOLTAGES AT TP10 THROUGH TP15 NORMAL
NO
CHECK ASSOCIATED COMPONENTS AND REPLACE AS NECESSARY
YES
Q4 AND ASSOCIATED COMPONENTS
NO
CHECK R214, R218, R219, C202, 207, AND C208

Table 5-7. Model 608E/F Troubleshooting Procedure (Continued)





SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and HP stock number of each part, together with any applicable notes. Miscellaneous parts are listed at the end of Table 6-1. Table 6-2 lists parts in alpha-numerical order of their HP stock number and provides the following information on each part.

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers (Table 6-3).

c. Manufacturer's stock number.

d. Total quantity used in the instrument (TQ column).

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office (see list at rear of this manual for addresses). Identify parts by their Hewlett-Packard stock numbers.

6-5. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= Filter	Q	= transistor		
BT	= battery	J	= jack	R	= resistor	VR	= voltage regulator
C	= capacitor	K	= relay	RT	= thermistor	W	= cable
CP	= coupler	L	= inductor	S	= switch	X	= socket
CR	= diode	LS	= loud speaker	T	= transformer	Y	= crystal
DL	= delay line	M	= meter	TB	= terminal board	Z	= tuned cavity, network
DS	= device signaling (lamp)	MK	= microphone	TP	= test point		
E	= misc electronic part	MP	= mechanical part	U	= integrated circuit		

ABBREVIATIONS

A	= amperes	H	= henries	N/O	= normally open	RMO	= rack mount only
AFC	= automatic frequency control	HDW	= hardware	NOM	= nominal	RMS	= root-mean square
		HEX	= hexagonal	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
AMPL	= amplifier	HG	= mercury			S-B	= slow-blow
		HR	= hour(s)			SCR	= screw
BFO	= beat frequency oscillator	Hz	= Hertz	NPN	= negative-positive-negative	SE	= selenium
		IF	= intermediate freq			SECT	= section(s)
BE CU	= beryllium copper	IMPG	= impregnated	NRFR	= not recommended for field replacement	SEMICON	= semiconductor
BH	= binder head	INCD	= incandescent			SI	= silicon
BP	= bandpass	INCL	= include(s)			SIL	= silver
BRS	= brass	INS	= insulation(ed)	NSR	= not separately replaceable	SL	= slide
BWO	= backward wave oscillator	INT	= internal			SPG	= spring
				OBD	= order by description	SPL	= special
CCW	= counterclockwise	K	= kilo = 1000			SST	= Stainless steel
CER	= ceramic			OH	= oval head	SR	= split ring
CMO	= cabinet mount only			OX	= oxide	STL	= steel
COEF	= coefficient	LH	= left hand				
COM	= common	LIN	= linear taper	P	= peak	TA	= tantalum
COMP	= composition	LK WASH	= lock washer	PC	= printed circuit	TD	= time delay
COMPL	= complete	LOG	= logarithmic taper	PF	= picofarads = 10^{-12} farads	TGL	= toggle
CONN	= connector	LPF	= low pass filter			THD	= thread
CP	= cadmium plate			PH BRZ	= phosphor bronze	TI	= titanium
CRT	= cathode-ray tube	M	= milli = 10^{-3}	PHL	= Phillips	TOL	= tolerance
CW	= clockwise	MEG	= meg = 10^{6}	PIV	= peak inverse voltage	TRIM	= trimmer
		MET FLM	= metal film			TWT	= traveling wave tube
DEPC	= deposited carbon	MET OX	= metallic oxide	PNP	= positive-negative-positive		
DR	= drive	MFR	= manufacturer				
		MHz	= mega Hertz	P/O	= part of	μ	= micro = 10^{-6}
ELECT	= electrolytic	MINAT	= miniature	POLY	= polystrene		
ENCAP	= encapsulated	MOM	= momentary	PORC	= porcelain		
EXT	= external	MOS	= metalized substrate	POS	= position(s)	VAR	= variable
				POT	= potentiometer	VDCW	= dc working volts
F	= farads	MTG	= mounting	PP	= peak-to-peak		
FH	= flat head	MY	= "mylar"	PT	= point		
FIL H	= Fillister head			PWV	= peak working voltage	W/	= with
FXD	= fixed	N	= nano (10^{-9})			W	= watts
		N/C	= normally closed	RECT	= rectifier	WIV	= working inverse voltage
G	= giga (10^{9})	NE	= neon	RF	= radio frequency		
GE	= germanium	NI PL	= nickel plate	RH	= round head or right hand	WW	= wirewound
GL	= glass					W/O	= without
GRD	= ground(ed)						

Table 6-1. Reference Designation Index

Reference Designation	Part No.	Description #	Note
AT1	00608-610	ATTENUATOR PLUNGER ASSY	
	5040-0232	WINDOW:DIAL ATTENUATOR	
C1		NOT ASSIGNED	
C2	0140-0071	C:FXD MICA 5600PF 1% 500WVDC	
C3	0140-0071	C:FXD MICA 5600PF 1% 500WVDC	
C4	0140-0085	C:FXD MICA 470PF 5% 500WVDC	
C5	0160-0018	C:FXD MY 0.22 UF 10% 400VDCW	
C6	0140-0020	C:FXD MICA 1800 PF 10% 500VDCW	
C7-C13		NOT ASSIGNED	
C14	0150-0019	C:FXD CER 1000 PF 20% 500VDCW	
C15	0150-0019	C:FXD CER 1000 PF 20% 500VDCW	
C16	0150-0028	C:FXD CER 100 PF 10% 500VDCW	
C17		THIS CAPACITOR IS NOT REPLACEABLE(TUNING CAPACITOR)	
C18	0133-0001	C:VAR GLASS 0.5-3 PF (MODEL 608E ONLY)	
C19	0150-0014	C:FXD CER 0.005 UF 500VDCW	
C20	0150-0010	C:FXD CER 47 PF 5% 500VDCW	
C21	0150-0010	C:FXD CER 47 PF 5% 500VDCW	
C22	0150-0009	C:FXD CER 10/0.5 PF 500VDCW	
C23	0133-0002	C:VAR GLASS 1 TO 12 PF	
C24	0150-0015	C:FXD TI 2.2 MMF 10% 500VDCW	
C25		NSR PART OF V6	
C26	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C27		NOT ASSIGNED	
C28	0150-0019	C:FXD CER 1000 PF 20% 500VDCW	
C29		NOT ASSIGNED	
C30	0160-2236	C:FXD CER 1.0-0.25 PF 500VDCW	
C31	0150-0019	C:FXD CER 1000 PF 20% 500VDCW	
C32	0133-0001	C:VAR GLASS 0.5-3 PF (MODEL 608F ONLY)	
C33	608D-82	C:FXD MICA 60 PF 10% 600VDCW	
C34	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C35	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C36	0160-0013	C:FXD MY 0.1 UF 10% 400VDCW	
C37		NSR PART OF ATTEN. PROBE ASSY	
C38	0140-0069	C:FXD MICA 550 PF 10% 500VDCW	
C39	0160-0013	C:FXD MY 0.1 UF 10% 400VDCW	
C40	0180-0020	C:FXD ELECT 80UF -20/+100% 450VDCW	
C41	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C42	0180-0020	C:FXD ELECT 80UF -20/+100% 450VDCW	
C43	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C44	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C45	0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	
C46A	0180-0018	C:FXD ELECT 2X10UF 450VDCW	
C46B		NOT USED:NSR PART OF C46A	
C47-C48		NOT ASSIGNED	
C49	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C50	0140-0020	C:FXD MICA 1800 PF 10% 500VDCW	
C51	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C52A,B	0180-0018	C:FXD ELECT 2X10UF 450VDCW	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	℗ Part No.	Description #	Note
C53	0140-0020	C:FXD MICA 1800 PF 10% 500VDCW	
C54		NOT ASSIGNED	
C55	0180-0018	C:FXD ELECT 2X10UF 450VDCW	
C56	0160-0013	C:FXD MY 0.1 UF 10% 400VDCW	
C57	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C58	0160-0013	C:FXD MY 0.1 UF 10% 400VDCW	
C59	0133-0001	C:VAR GLASS 0.5-3 PF	
C60	0150-0008	C:FXD CER 5 PF 500VDCW	
C61		NOT ASSIGNED	
C62	0180-0094	C:FXD ELECT 100UF 25VDCW	
C63-C67		NOT ASSIGNED	
C68	608D-59H	SPECIAL TRIMMER:FINE FREQ ADJUST	
C69		NSR:PART OF ATTEN. PROBE ASSY	
C70	0150-0006	C:FXD CER 110 PF 2% 500VDCW	
C71	0150-0038	C:FXD CER 75 PF 1% 500VDCW	
C72	0150-0037	C:FXD CER 100 PF 1% 500VDCW	
C73	0150-0032	C:FXD CER 10 1 PF 500VDCW	
C74	0150-0019	C:FXD CER 1000 PF 20% 500VDCW	
C75	0180-0057	C:FXD ELECT 1000UF 25VDCW	
C76	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
C77-C199		NOT ASSIGNED	
C200	0150-0096	C:FXD CER 0.05 UF +80-20% 100VDCW	
C201	0150-0096	C:FXD CER 0.05 UF +80-20% 100VDCW	
C202	0180-0094	C:FXD ELECT 100UF 25VDCW	
C203	0180-0105	C:FXD ELECT SEMI-POLARIZED 50UF 25VDCW	
C204	0180-0105	C:FXD ELECT SEMI-POLARIZED 50UF 25VDCW	
C205	0180-0119	C:FXD ELECT 1UF -10+100% 25VDCW	
C206	0180-0119	C:FXD ELECT 1UF -10+100% 25VDCW	
C207	0140-0160	C:FXD MICA 3400 PF 5% 500VDCW	
C208	0180-0094	C:FXD ELECT 100UF 25VDCW	
C209	0140-0176	C:FXD MICA 100 PF 2%	
C210	0160-0168	C:FXD MY 0.1 UF 10% 200VDCW	
C211	0140-0176	C:FXD MICA 100 PF 2%	
C212	0160-0168	C:FXD MY 0.1 UF 10% 200VDCW	
C213	0150-0096	C:FXD CER 0.05 UF +80-20% 100VDCW	
C214	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	
C215	0180-0059	C:FXD ELECT 10 UF +75-10% 25VDCW	
C216	0180-1819	C:FXD ELECT 100UF -10+100% 50VDCW	
C217		NOT ASSIGNED	
C218	0150-0045	C:FXD TI 8.2 PF 5% 500VDCW	
C219	0150-0023	C:FXD CER 2000 PF 20% 1000VDCW	
C220	0150-0023	C:FXD CER 2000 PF 20% 1000VDCW	
C221	0150-0023	C:FXD CER 2000 PF 20% 1000VDCW	
C222	0150-0023	C:FXD CER 2000 PF 20% 1000VDCW	
C223	0180-0119	C:FXD ELECT 1UF -10+100% 25VDCW	
C224	0140-0069	C:FXD MICA 550 PF 10% 500VDCW	
C225	0150-0089	C:FXD CER 4.7 PF 500VDCW (MODEL 608F ONLY)	
C226	0150-0089	C:FXD CER 4.7 PF 500VDCW (MODEL 608F ONLY)	
C227	0160-2295	C:FXD FEED-THRU 100 PF 20% 500VDCW (MODEL 608F ONLY)	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	Part No.	Description #	Note
C228	0180-0089	C:FXD ELECT 10UF-10%+100% 150VDCW (MODEL 608F ONLY)	
C229	0160-2234	C:FXD CER 0.51-0.25 PF 500VDCW (MODEL 608F ONLY)VALUE SELECTED IN TEST	
C230	0160-2235	C:FXD CER 0.75 UF 500VDCW (MODEL 608F ONLY)VALUE SELECTED IN TEST	
C231	0160-2234	C:FXD CER 0.51-0.25 PF 500VDCW (MODEL 608F ONLY)VALUE SELECTED IN TEST	
CR1	1901-0518	DIODE:HOT CARRIER	
CR2	1900-0017	DIODE:SYLVANIA	
CR3-CR6		NOT ASSIGNED	
CR7	1910-0002	DIODE:GERMANIUM	
CR8	1901-0029	DIODE:SILICON 600 PIV	
CR9	1901-0029	DIODE:SILICON 600 PIV	
CR10	1901-0029	DIODE:SILICON 600 PIV	
CR11	1901-0029	DIODE:SILICON 600 PIV	
CR12	1901-0028	DIODE:SILICON 0.75A 400PIV	
CR13	1901-0028	DIODE:SILICON 0.75A 400PIV	
CR14	1901-0028	DIODE:SILICON 0.75A 400PIV	
CR15	1901-0028	DIODE:SILICON 0.75A 400PIV	
CR16	1901-0026	DIODE:SILICON 0.75A 200 PIV	
CR17	1901-0026	DIODE:SILICON 0.75A 200 PIV	
CR18	1901-0026	DIODE:SILICON 0.75A 200 PIV	
CR19	1901-0026	DIODE:SILICON 0.75A 200 PIV	
CR20	1902-3129	DIODE BREAKDOWN:7.50V 2%	
CR21	1901-0025	DIODE:SILICON 100WV 100MA	
CR22	1910-0011	DIODE:GERMANIUM 5MA AT 1V	
CR23	1901-0025	DIODE:SILICON 100WV 100MA	
CR24		NOT ASSIGNED	
CR25	1901-0025	DIODE:SILICON 100WV 100MA	
CR26	1902-0227	DIODE,BREAKDOWN:22.6V 5% 1.5W	
CR27	1901-0025	DIODE:SILICON 100WV 100MA	
CR28	1902-0049	DIODE,BREAKDOWN: 6.19V 5%	
CR29	1901-0026	DIODE:SILICON 0.75A 200 PIV	
CR30	1901-0026	DIODE:SILICON 0.75A 200 PIV	
CR31	0122-0031	C:VOLTAGE VAR 15 PF 20% 100WV (MODEL 608F ONLY)	
CR32	0122-0031	C:VOLTAGE VAR 15 PF 20% 100WV (MODEL 608F ONLY)	
CR33	1901-0025	DIODE:SILICON 100WV 100MA	
DS1	2140-0007	LAMP:INCANDESCENT 250V 10W	
	1450-0013	SOCKET:CANDELABRA	
DS2		NOT ASSIGNED	
DS3	2140-0009	LAMP:INCANDESCENT 6-8V TYPE 47 (DIAL LIGHT)	
	1450-0009	LAMPHOLDER:MINIATURE BAYONET BASE	
DS4	2140-0009	LAMP:INCANDESCENT 6-8V TYPE 47 (POWER LIGHT)	
	1450-0009	LAMPHOLDER:MINIATURE BAYONET BASE	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	hp Part No.	Description #	Note
F1	2110-0014	FUSE:CARTRIDGE 4 AMP 125V SLOW BLOW (115V OPERATION)	
F1	2110-0006	FUSE:CARTRIDGE 2AMP 125V SLOW BLOW (230V OPERATION)	
F2		NOT ASSIGNED	
F3	2110-0004	FUSE:CARTRIDGE 1/4 AMP 250V	
FL1	00608-624	FILTER:VARICAP (MODEL 608F ONLY)	
FL2	608A-27D	FILTER:D GREEN	
FL3		NOT ASSIGNED	
FL4	608A-27A	FILTER:A RED	
FL5	608A-27D	FILTER:D GREEN	
FL6	608D-27C	FILTER:RF(MOD,BLUE)	
FL7	608A-27A	FILTER:A RED	
FL8	608D-27B	FILTER:RF(WHITE)	
FL9	608D-60M	CHOKE:RF	
FL10	608A-27D	FILTER:D GREEN	
FL11	608A-27D	FILTER:D GREEN	
J1		NOT ASSIGNED	
J2	1250-0001	CONNECTOR:RF BNC BULKHEAD MOUNT JACK (AM/PULSE MOD. INPUT)	
J3	1251-0071	JACK:TELEPHONE FOR 2-COND PLUG (XTAL CAL. OUTPUT)	
J4	1250-0099	CONNECTOR:RF REAR PANEL MOUNT JACK (RF OUTPUT)	
	1250-0144	CONNECTOR:RECEPTACLE JACK CO-AXIAL TYPE	
J5		NSR PART OF W1	
	1250-0053	CONNECTOR:RF BNC CAP AND CHAIN	
J6	1250-0001	CONNECTOR:RF BNC BULKHEAD MOUNT JACK (MODEL 608F ONLY)FREQ CONTROL INPUT	
J7	1250-0001	CONNECTOR:RF BNC BULKHEAD MOUNT JACK (MODEL 608F ONLY)FREQ ANALOG OUTPUT	
	00608-603	TURRET OSCILLATOR ASSY (MODEL 608E ONLY)	
	00608-623	OSCILLATOR TURRET ASSY (MODEL 608F ONLY)	
L1		NSR:PART OF OSC. TURRET ASSY	
L2		NSR:PART OF OSC. TURRET ASSY	
L3		NSR:PART OF OSC. TURRET ASSY	
L4		NSR:PART OF OSC. TURRET ASSY	
L5		NSR:PART OF OSC. TURRET ASSY	
L6	9140-0008	COIL:VAR 10.5-20 UH	
L7	9140-0035	COIL:VAR CT 10.5 UH	
L8-L10		NOT ASSIGNED	
L11	608D-60K	CHOKE:RF	
	608C-60A	TURRET ASSY:AMP(MODEL 608E ONLY)	
	00608-626	AMPLIFIER TURRET ASSY(MODEL 608F ONLY)	
L12-L17		NSR:PART OF AMPLIFIER TURRET ASSY	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	Part No.	Description #	Note
L18	9140-0036	COIL:VAR CT 450-500 UH	
L19		NOT ASSIGNED	
L20	9140-0096	COIL:FXD RF 1 UH	
L21		NOT ASSIGNED	
L22	9140-0026	COIL:FXD RF 6.8 UH	
M1	1120-0396	METER (MODEL 608E ONLY)RF OUTPUT	
M1	1120-1505	METER:50UA (MODEL 608F ONLY)RF OUTPUT	
M2	1120-0397	METER PERCENT MODULATION	
P1	8120-0015	POWER CABLE	
Q1	1850-0087	TRANSISTOR:GERMANIUM 2N1544 PNP	
Q2	1854-0071	TRANSISTOR:SILICON NPN	
Q3	1854-0071	TRANSISTOR:SILICON NPN	
Q4	1854-0071	TRANSISTOR:SILICON NPN	
Q5	1854-0005	TRANSISTOR:SILICON NPN 2N708	
Q6	1854-0005	TRANSISTOR:SILICON NPN 2N708	
Q7	1853-0012	TRANSISTOR:PNP SILICON 2N2904A	
	1205-0011	HEAT DISSIPATOR:FOR TO-5 AND TO-9 CASES	
Q8	1854-0003	TRANSISTOR:NPN SILICON	
	1205-0011	HEAT DISSIPATOR:FOR TO-5 AND TO-9 CASES	
Q9	1854-0003	TRANSISTOR:NPN SILICON	
	1205-0011	HEAT DISSIPATOR:FOR TO-5 AND TO-9 CASES	
Q10	1854-0003	TRANSISTOR:NPN SILICON	
Q11	1854-0039	TRANSISTOR:SILICON 2N3053	
	1205-0011	HEAT DISSIPATOR:FOR TO-5 AND TO-9 CASES	
R1- R2		NOT ASSIGNED	
R3	0727-0184	R:FXD DEPC 28.4 OHM 1% 1/2W	
R4	0730-0058	R:FXD DEPC 75K OHM 1% 1W	
R5	0727-0184	R:FXD DEPC 28.4 OHM 1% 1/2W	
R6	0730-0058	R:FXD DEPC 75K OHM 1% 1W	
R7	2100-0036	R:VAR COMP 1000 OHM 20% 1/4W	
R8	0690-1221	R:FXD COMP 1.2K OHM 10% 1W	
R9	0690-1541	R:FXD COMP 150K OHM 10% 1W	
R10	0690-1521	R:FXD COMP 1500 OHM 10% 1W	
R11	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R12	0690-1541	R:FXD COMP 150K OHM 10% 1W	
R13		NOT ASSIGNED	
R14	0693-1231	R:FXD COMP 12K OHM 10% 2W	
R15- R32		NOT ASSIGNED	
R33	0819-0003	R:FXD WW 5000 OHM 10% 20W	
R34- R42		NOT ASSIGNED	
R43	0816-0006	R:FXD WW 5000 OHM 10% 10W	
R44- R47		NOT ASSIGNED	
R48	0687-2741	R:FXD COMP 270K OHM 10% 1/2W	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	Part No.	Description #	Note
R49	0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	
R50	0690-1031	R:FXD COMP 10K OHM 10% 1W	
R51	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R52	0690-1241	R:FXD COMP 120K OHM 10% 1W	
R53	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R54	0690-1241	R:FXD COMP 120K OHM 10% 1W	
R55	0693-2731	R:FXD COMP 27K OHM 10% 2W	
R56	2100-0159	R:VAR COMP 1 MEGOHM 20% 1/8W	
R57	0693-4711	R:FXD COMP 470 OHM 10% 2W	
R58	0721-0006	R:FXD DEPC 53.3 OHM 1% 1/8W	
R59	0721-0006	R:FXD DEPC 53.3 OHM 1% 1/8W	
R60	0684-1211	R:FXD COMP 120 OHM 10% 1/4W	
R60		(VALUE SELECTED IN TEST)	
R61-R64		NOT ASSIGNED	
R65	0690-1231	R:FXD COMP 12K OHM 10% 1W	
R66	0690-1541	R:FXD COMP 150K OHM 10% 1W	
R67	0690-1851	R:FXD COMP 1.8 MEGOHM 10% 1W	
R68	0690-1021	R:FXD COMP 1000 OHM 10% 1W	
R69	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R70	0690-1541	R:FXD COMP 150K OHM 10% 1W	
R71	2100-0157	R:VAR COMP 50K OHM 20% LIN 1/3W	
R72	0690-2241	R:FXD COMP 220K OHM 10% 1W	
R73	0690-2731	R:FXD COMP 27K OHM 10% 1W	
R74	0693-6831	R:FXD COMP 68K OHM 10% 2W	
R75	0690-3331	R:FXD COMP 33K OHM 10% 1W	
R76	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R77	0690-1021	R:FXD COMP 1000 OHM 10% 1W	
R78	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R79	0690-2241	R:FXD COMP 220K OHM 10% 1W	
R80	2100-0157	R:VAR COMP 50K OHM 20% LIN 1/3W	
R81	0690-2241	R:FXD COMP 220K OHM 10% 1W	
R82-R87		NOT ASSIGNED	
R88	0687-4741	R:FXD COMP 470K OHM 10% 1/2W	
R89	0687-5601	R:FXD COMP 56 OHM 10% 1/2W	
R90	0690-8201	R:FXD COMP 82 OHM 10% 1W	
R91	0690-8201	R:FXD COMP 82 OHM 10% 1W	
R92	0693-2231	R:FXD COMP 22K OHM 10% 2W	
R93	0690-8231	R:FXD COMP 82K OHM 10% 1W	
R94	0687-4741	R:FXD COMP 470K OHM 10% 1/2W	
R95	0687-5601	R:FXD COMP 56 OHM 10% 1/2W	
R96	0690-1511	R:FXD COMP 150 OHM 10% 1W	
R97	0693-2231	R:FXD COMP 22K OHM 10% 2W	
R98	0690-8231	R:FXD COMP 82K OHM 10% 1W	
R99	0690-1821	R:FXD COMP 1800 OHM 10% 1W	
R100	0690-1061	R:FXD COMP 10 MEGOHM 10% 1W	
R101	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R102	0693-2231	R:FXD COMP 22K OHM 10% 2W	
R103		NOT ASSIGNED	
R104	2100-0156	R:VAR COMP 10K OHM 20% LIN 1/2W	
R105	0690-2211	R:FXD COMP 220 OHM 10% 1W	
R106	2100-0156	R:VAR COMP 10K OHM 20% LIN 1/2W	
R107	0693-2231	R:FXD COMP 22K OHM 10% 2W	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	hp Part No.	Description #	Note
R108-			
R113		NOT ASSIGNED	
R114		NSR:PART OF FL9	
R115	0690-5631	R:FXD COMP 56K OHM 10% 1W	
R116-			
R117		NOT ASSIGNED	
R118	0690-1021	R:FXD COMP 1000 OHM 10% 1W	
R119	0690-1521	R:FXD COMP 1500 OHM 10% 1W	
R120-			
R121		NOT ASSIGNED	
R122	0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	
R123	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	
R124	0818-0027	R:FXD WW 60 OHM 5% 40W	
R125	0819-0022	R:FXD WW 50 OHM 5% 20W	
R126-			
R128		NOT ASSIGNED	
R129	0813-0029	R:FXD WW 1 OHM 3% 3W	
R130-			
R199		NOT ASSIGNED	
R200	0757-0429	R:FXD MET FLM 1.82K OHM 1% 1/8W	
R201	0757-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	
R202	2100-0092	R:VAR COMP 10K OHM 20% LIN 1/5W	
R203	0757-0854	R:FXD MET FLM 56.2K OHM 1% 1/2W	
R204	2100-0151	R:VAR 500 OHM 20% 2/10W LIN	
R205	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
R206	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
R207	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
R208	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
R209	2100-0281	R:VAR WW 100 OHM 20% LIN 1-1/2W	
R210	2100-0235	R:VAR COMP 5K OHM 20% LIN 2.25W	
R211	0757-0447	R:FXD MET FLM 16.2K OHM 1% 1/8W	
R212	2100-1619	R:VAR COMP DUAL 5K-50K OHM 20% 10C LOG	
R213	0757-0464	R:FXD MET FLM 90.9K OHM 1% 1/8W	
R214	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W (MODEL 608E ONLY)	
R214	0757-0413	R:FXD MET FLM 392 OHM 1% 1/8W (MODEL 608F ONLY)	
R215	0757-0419	R:FXD MET FLM 681 OHM 1% 1/8W	
R216	0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	
R217	0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	
R218	0757-0405	R:FXD MET FLM 162 OHM 1% 1/8W	
R219	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
R220	0757-0437	R:FXD MET FLM 4750 OHM 1% 1/8W	
R221	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
R222	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
R223	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
R224	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
R225	0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	
R226	2100-1619	R:VAR COMP DUAL 5K-50K OHM 20% 10C LOG	
R227		NOT ASSIGNED	
R228	0757-0852	R:FXD MET FLM 47.5K OHM 1% 1/2W	
R229	0757-0429	R:FXD MET FLM 1.82K OHM 1% 1/8W	
R230	0757-0811	R:FXD MET FLM 392 OHM 1% 1/2W	
R231	0684-1001	R:FXD COMP 10 OHM 10% 1/4W	
R232	0684-1001	R:FXD COMP 10 OHM 10% 1/4W	
R233	0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	
R234		NOT ASSIGNED	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	Part No.	Description #	Note
R235	0687-6841	R:FXD COMP 680K OHM 10% 1/2W	
R236	0757-0434	R:FXD MET FLM 3.65K OHM 1% 1/8W	
R237	0698-4477	R:FXD MET FLM 10.5K OHM 1% 1/8W (VALUE SELECTED IN TEST)	
R238	0757-0290	R:FXD MET FLM 6.19K OHM 1% 1/8W	
R239	0757-0854	R:FXD MET FLM 56.2K OHM 1% 1/2W	
R240	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
R241	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
R242	0684-3901	R:FXD COMP 39 OHM 10% 1/4W	
R243	0757-0411	R:FXD MET FLM 332 OHM 1% 1/8W	
R244	0698-3430	R:FXD MET FLM 21.5 OHM 1% 1/8W	
R245	0684-1511	R:FXD COMP 150 OHM 10% 1/4W	
R246	0757-0197	R:FXD MET FLM 1500 OHM 1% 1/2W	
R247	0757-0197	R:FXD MET FLM 1500 OHM 1% 1/2W	
R248	0757-0841	R:FXD MET FLM 12.1K OHM 1% 1/2W	
R249	0757-0801	R:FXD MET FLM 150 OHM 1% 1/2W	
R250	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
R251	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W (MODEL 608E ONLY)	
R251	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W (MODEL 608F ONLY)	
R252	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
R253	0761-0021	R:FXD MET FLM 1K OHM 5% 1W	
R254	0761-0058	R:FXD MET OX 750 OHM 5% 1W	
R255	0816-0032	R:FXD WW 4K OHM 5% 10W	
R256	0812-0050	R:FXD WW 3K OHM 5% 5W	
R257	0727-0002	R:FXD DEPC 3.0 OHM 1% 1/2W	
R258	0690-1841	R:FXD COMP 180K OHM 10% 1W	
R259		NOT ASSIGNED	
R260	0812-0038	R:FXD WW 8.66K OHM 3% 5W	
R261	0757-0457	R:FXD MET FLM 47.5K OHM 1% 1/8W	
R262	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
R263	0757-0457	R:FXD MET FLM 47.5K OHM 1% 1/8W	
R264	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W (MODEL 608F ONLY)	
R265	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W (MODEL 608F ONLY)	
R266	0757-0437	R:FXD MET FLM 4750 OHM 1% 1/8W (MODEL 608F ONLY)	
R267	0698-3415	R:FXD MET FLM 19.6K OHM 1% 1/2W (MODEL 608F ONLY)	
R268	0757-0833	R:FXD MET FLM 5.11K OHM 1% 1/2W (MODEL 608F ONLY)	
R269	2100-1750	R:VAR COMP 4K OHM 10% S-LIN 2.25W (MODEL 608F ONLY)	
R270	0757-0405	R:FXD MET FLM 162 OHM 1% 1/8W	
R271	0757-0838	R:FXD MET FLM 9.09K OHM 1% 1/2W (MODEL 608F ONLY)	
R272	0816-0002	R:FXD WW 3000 OHM 10% 10W	
RFC1	9170-0029	BEAD:FERRITE	
S1		NOT ASSIGNED	
S2	3101-0033	SWITCH:SLIDE DPDT(115-230V)	
S3	3101-0003	SWITCH:TOGGLE DPST(ON-NONE-OFF)	
S4	3101-0012	SWITCH:TOG DPDT ON OFF ON (XTAL CAL)	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	℗ Part No.	Description #	Note
S5		NOT ASSIGNED	
S6	3102-0006	SWITCH: SENSITIVE SPDT PIN PLUNGER	
S7	3100-0899	SWITCH:ROTARY	
S7		(MOD SELECTOR)	
T1	9100-2289	TRANSFORMER:POWER	
T2	9100-0342	TRANSFORMER:POWER	
T3	9120-0018	TRANSFORMER:AUDIO 15K : 600 OHM	
V1		NOT ASSIGNED	
V2A	1932-0066	ELECTRON TUBE:DUAL TRIODE	
V2B		NSR:PART OF V2A	
	1200-0008	SOCKET:ELECTRON TUBE 9-PIN MINIATURE	
V3-V5		NOT ASSIGNED	
V6	1921-0001	ELECTRON TUBE: UHF PENCIL TROIDE	
	1200-0010	SOCKET:TUBE FOR 2-PIN PENCIL TUBE	
	608D-59A-4	SOCKET:OSCILLATOR GRID	
	608D-59A-3	SOCKET:OSCILLATOR TUBE	
	612A-38A	WRENCH:TUBE	
V7		NOT ASSIGNED	
V8	1921-0002	ELECTRON TUBE: UHF PENCIL TRIODE	
	1200-0010	SOCKET:TUBE FOR 2-PIN PENCIL TUBE	
	608D-58A	CONTACT:AMP GRID	
	612A-38A	WRENCH:TUBE	
V9	1933-0013	TUBE:ELECTRON 6U8A	
V10A	1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	
V10B		NOT USED	
	1200-0008	SOCKET:ELECTRON TUBE 9-PIN MINIATURE	
V11	1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	
	1200-0008	SOCKET:ELECTRON TUBE 9-PIN MINIATURE	
V12	1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	
	1200-0009	SOCKET:TUBE 7-PIN MINAT	
V13A	1932-0010	ELECTRON TUBE: 6080 DUAL TRIODE	
V13B		NSR:PART OF V13B	
	1200-0005	SOCKET:TUBE,OCTAL	
V14	1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	
	1200-0009	SOCKET:TUBE 7-PIN MINAT	
V15	1940-0001	ELECTRON TUBE:5651	
	1200-0009	SOCKET:TUBE 7-PIN MINAT	
V16A	1932-0010	ELECTRON TUBE: 6080 DUAL TRIODE	
V16B		NSR:PART OF V16A	
	1200-0005	SOCKET:TUBE,OCTAL	
V17		NOT ASSIGNED	
V18	1923-0017	ELECTRON TUBE:6AH6 PENTODE	
	1200-0009	SOCKET:TUBE 7-PIN MINAT	
V19	1923-0017	ELECTRON TUBE:6AH6 PENTODE	
	1200-0009	SOCKET:TUBE 7-PIN MINAT	
V20	1930-0013	ELECTRON TUBE: 6AL5 TWIN DIODE	
	1200-0009	SOCKET:TUBE 7-PIN MINAT	
V21A	1932-0029	ELECTRON TUBE:DUAL TRIODE	
V21B		NSR:PART OF V21A	
	1200-0008	SOCKET:ELECTRON TUBE 9-PIN MINIATURE	
V22	1921-0036	ELECTRON TUBE:UHF TRIODE 9-PIN BASE	
	1200-0019	SOCKET:TUBE 9-PIN MINIATURE	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont.)

Reference Designation	℗ Part No.	Description #	Note
W1	00608-60037	CABLE:UNCAL OUTPUT ASSY	
XY1	1200-0028	SOCKET:CRYSTAL 2 PIN	
Y1	0410-0009	CRYSTAL:QUARTZ 5MC	
		MISCELLANEOUS	
	608C-40A	ATTENUATOR DIAL ASSY	
	00608-610	ATTENUATOR PLUNGER ASSY	
	608D-75A	BOARD:RESISTOR ASSY	
	608D-75B	BOARD:RESISTOR ASSY	
	608D-75T	BOARD:RECTIFIER ASSY	
	00608-604	ASSY:RESISTOR RECTIFIER BOARD	
	00608-613	BOARD:RESISTOR ASSY	
	00608-614	BOARD:RESISTOR ASSY	
	00608-601	ALC BOARD ASSY (MODEL 608E ONLY)	
	00608-621	BOARD:ALC ASSY (MODEL 608F ONLY)	
	00608-625	BOARD:VARICAP ASSY (MODEL 608F ONLY)	
	00608-602	BUFFER ASSY (MODEL 608E ONLY)	
	00608-622	BUFFER ASSY (MODEL 608F ONLY)	
	608D-44S	CABINET ASSY	
	608D-44R	CABINET ASSY:RACK	
	608D-16J	CABLE:CRYSTAL CALIBRATOR	
	608D-16R	CABLE:CRYSTAL CALIBRATOR ADJUST	
	00608-606	CABLE:POWER HARNESS	
	00608-607	CABLE:PANEL HARNESS	
	00608-611	CABLE:LEVELLER IN	
	00608-612	CABLE:LEVELLER OUT	
	00608-60037	CABLE:UNCAL OUTPUT ASSY	
	608D-40C	DIAL:FREQUENCY VERNIER	
	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
	00608-600	GENERATOR ASSY (MODEL 608E ONLY)	
	00608-620	GENERATOR ASSY (MODEL 608F ONLY)	
	0370-0025	KNOB:BLACK,OFFSET XTAL CAL GAIN	
	0370-0026	KNOB:BLK W/ARROW 3/4" OD 1/8" SHAFT FINE FREQUENCY	
	0370-0028	KNOB:ROUND BLACK 1" DIA MOD METER AND RF OUTPUT	
	0370-0029	KNOB:BLACK W/ARROW 1" DIA 1/4" SHAFT AMPLIFIER TRIMMER	
	0370-0035	KNOB:SKIRTED BAR 1" DIA MOD(SWITCH)	
	0370-0049	KNOB:BLK SKIRTED BAR 1" DIA 0.375"SHAFT FREQUENCY RANGE	
	0370-0050	HANDLE:CRANK ONLY 3/8 IN. OD	
	608D-83C	WINDOW:FREQ DIAL	
	612A-38A	WRENCH:TUBE	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts

℗ Part No.	Description #	Mfr.	Mfr. Part No.	TQ 608E	TQ 608
0122-0031	C:VOLTAGE VAR 15 PF 20% 100WV	28480	0122-0031		2
0133-0001	C:VAR GLASS 0.5-3 PF	28480	0133-0001	2	2
0133-0002	C:VAR GLASS 1 TO 12 PF	28480	0133-0002	1	1
0140-0020	C:FXD MICA 1800 PF 10% 500VDCW	00853	RCM30E182K	3	3
0140-0069	C:FXD MICA 550 PF 10% 500VDCW	00853	TYPE M 100E10	2	2
0140-0071	C:FXD MICA 5600PF 1% 500WVDC	28480	0140-0071	2	2
0140-0085	C:FXD MICA 470PF 5% 500WVDC	28480	0140-0085	1	1
0140-0160	C:FXD MICA 3400 PF 5% 500VDCW	28480	0140-0160	1	1
0140-0176	C:FXD MICA 100 PF 2%	28480	0140-0176	2	2
0150-0006	C:FXD CER 110 PF 2% 500VDCW	04222	TYPE SI-19	1	1
0150-0008	C:FXD CER 5 PF 500VDCW	28480	0150-0008	1	1
0150-0009	C:FXD CER 10/0.5 PF 500VDCW	72982	315-000-C0G0-100D	1	1
0150-0010	C:FXD CER 47 PF 5% 500VDCW	04222	SI 47PFNPO	2	2
0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3	9	9
0150-0014	C:FXD CER 0.005 UF 500VDCW	96095	D1-4	1	1
0150-0015	C:FXD TI 2.2 MMF 10% 500VDCW	78488	TYPE GA	1	1
0150-0019	C:FXD CER 1000 PF 20% 500VDCW	72982	327005X5U0102M	5	5
0150-0023	C:FXD CER 2000 PF 20% 1000VDCW	56289	19C203A	4	4
0150-0028	C:FXD CER 100 PF 10% 500VDCW	56289	TYPE 501C18-CBT	1	1
0150-0032	C:FXD CER 10 1 PF 500VDCW	72982	315-000-U2J0-100F	1	1
0150-0037	C:FXD CER 100 PF 1% 500VDCW	72982	821-000-C0G0-101F	1	1
0150-0038	C:FXD CER 75 PF 1% 500VDCW	04222	STYLE CN7	1	1
0150-0045	C:FXD TI 8.2 PF 5% 500VDCW	78488	TYPE GA	1	1
0150-0089	C:FXD CER 4.7 PF 500VDCW	72982	301-000-C0H0 479C		2
0150-0096	C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA	3	3
0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML	1	1
0160-0013	C:FXD MY 0.1 UF 10% 400VDCW	56289	160P10494-PMD	4	4
0160-0018	C:FXD MY 0.22 UF 10% 400VDCW	28480	0160-0018	1	1
0160-0168	C:FXD MY 0.1 UF 10% 200VDCW	28480	0160-0168	2	2
0160-2234	C:FXD CER 0.51-0.25 PF 500VDCW	72982	301-000-C0K0-518C		2
0160-2235	C:FXD CER 0.75 UF 500VDCW	72982	301-000-C0K0 758C		1
0160-2236	C:FXD CER 1.0-0.25 PF 500VDCW	72982	301-000-C0K0-109C	1	1
0160-2295	C:FXD FEED-THRU 100 PF 20% 500VDCW	28480	0160-2295		1
0180-0018	C:FXD ELECT 2X10UF 450VDCW	14655	KP 10196 1	3	3
0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	14655	CE41F450R	1	1
0180-0020	C:FXD ELECT 80UF -20/+100% 450VDCW	14655	KP10202ISS0	2	2
0180-0057	C:FXD ELECT 1000UF 25VDCW	56289	D32606	1	1
0180-0059	C:FXD ELECT 10 UF +75-10% 25VDCW	28480	0180-0059	1	1
0180-0089	C:FXD ELECT 10UF-10%+100% 150VDCW	56289	30D106G150DF4		1
0180-0094	C:FXD ELECT 100UF 25VDCW	56289	30D107G025DH4	3	3
0180-0105	C:FXD ELECT SEMI-POLARIZED 50UF 25VDCW	56289	D34114	2	2
0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	56289	150D275X9035 B2	1	1
0180-0119	C:FXD ELECT 1UF -10+100% 25VDCW	56289	30D105G025AA4	3	3
0180-1819	C:FXD ELECT 100UF -10+100% 50VDCW	28480	0180-1819	1	1
0370-0025	KNOB:BLACK,OFFSET	28480	0370-0025	1	1
0370-0026	KNOB:BLK W/ARROW 3/4" OD 1/8" SHAFT	28480	0370-0026	1	1
0370-0028	KNOB:ROUND BLACK 1" DIA	28480	0370-0028	1	1
0370-0029	KNOB:BLACK W/ARROW 1" DIA 1/4" SHAFT	28480	0370-0029	1	1
0370-0035	KNOB:SKIRTED BAR 1" DIA	28480	0370-0035	1	1
0370-0049	KNOB:BLK SKIRTED BAR 1" DIA 0.375"SHAFT	28480	0370-0049	1	1
0370-0050	HANDLE:CRANK ONLY 3/8 IN. OD	28480	0370-0050	1	1
0410-0009	CRYSTAL:QUARTZ 5MC	28480	0410-0009	1	1
0684-1001	R:FXD COMP 10 OHM 10% 1/4W	01121	CB 1001	2	2
0684-1211	R:FXD COMP 120 OHM 10% 1/4W	01121	CB 1211	1	1

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont.)

℗ Part No.	Description #	Mfr.	Mfr. Part No.	TQ 608E	TQ 608F
0684-1511	R:FXD COMP 150 OHM 10% 1/4W	01121	CB 1511	1	1
0684-3901	R:FXD COMP 39 OHM 10% 1/4W	01121	CB 3901	1	1
0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	01121	EB 1021	1	1
0687-1041	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041	1	1
0687-2731	R:FXD COMP 27K OHM 10% 1/2W	01121	EB 2731	1	1
0687-2741	R:FXD COMP 270K OHM 10% 1/2W	01121	EB 2741	1	1
0687-4741	R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741	2	2
0687-5601	R:FXD COMP 56 OHM 10% 1/2W	01121	EB 5601	2	2
0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	01121	EB 5621	1	1
0687-6841	R:FXD COMP 680K OHM 10% 1/2W	01121	EB 6841	1	1
0690-1021	R:FXD COMP 1000 OHM 10% 1W	01121	GB 1021	3	3
0690-1031	R:FXD COMP 10K OHM 10% 1W	01121	GB 1031	1	1
0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	01121	GB 1051	6	6
0690-1061	R:FXD COMP 10 MEGOHM 10% 1W	01121	GB 1061	1	1
0690-1221	R:FXD COMP 1.2K OHM 10% 1W	01121	GB 1221	1	1
0690-1231	R:FXD COMP 12K OHM 10% 1W	01121	GB 1231	1	1
0690-1241	R:FXD COMP 120K OHM 10% 1W	01121	GB 1241	2	2
0690-1511	R:FXD COMP 150 OHM 10% 1W	01121	GB 1511	1	1
0690-1521	R:FXD COMP 1500 OHM 10% 1W	01121	GB 1521	2	2
0690-1541	R:FXD COMP 150K OHM 10% 1W	01121	GB 1541	4	4
0690-1821	R:FXD COMP 1800 OHM 10% 1W	01121	GB 1821	1	1
0690-1841	R:FXD COMP 180K OHM 10% 1W	01121	GB 1841	1	1
0690-1851	R:FXD COMP 1.8 MEGOHM 10% 1W	01121	GB 1851	1	1
0690-2211	R:FXD COMP 220 OHM 10% 1W	01121	GB 2211	1	1
0690-2241	R:FXD COMP 220K OHM 10% 1W	01121	GB 2241	3	3
0690-2731	R:FXD COMP 27K OHM 10% 1W	01121	GB 2731	1	1
0690-3331	R:FXD COMP 33K OHM 10% 1W	01121	GB 3331	1	1
0690-5631	R:FXD COMP 56K OHM 10% 1W	01121	GB 5631	1	1
0690-8201	R:FXD COMP 82 OHM 10% 1W	01121	GB 8201	2	2
0690-8231	R:FXD COMP 82K OHM 10% 1W	01121	GB 8231	2	2
0693-1231	R:FXD COMP 12K OHM 10% 2W	01121	HB 1231	1	1
0693-2231	R:FXD COMP 22K OHM 10% 2W	01121	HB 2231	4	4
0693-2731	R:FXD COMP 27K OHM 10% 2W	01121	HB 2731	1	1
0693-4711	R:FXD COMP 470 OHM 10% 2W	01121	HB 4711	1	1
0693-6831	R:FXD COMP 68K OHM 10% 2W	01121	HB 6831	1	1
0698-3415	R:FXD MET FLM 19.6K OHM 1% 1/2W	28480	0698-3415		1
0698-3430	R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430	1	1
0698-4477	R:FXD MET FLM 10.5K OHM 1% 1/8W	28480	0698-4477	1	1
0721-0006	R:FXD DEPC 53.3 OHM 1% 1/8W	28480	0721-0006	2	2
0727-0002	R:FXD DEPC 3.0 OHM 1% 1/2W	28480	0727-0002	1	1
0727-0184	R:FXD DEPC 28.4 OHM 1% 1/2W	28480	0727-0184	2	2
0730-0058	R:FXD DEPC 75K OHM 1% 1W	28480	0730-0058	2	2
0757-0197	R:FXD MET FLM 1500 OHM 1% 1/2W	28480	0757-0197	2	2
0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200	1	1
0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	28480	0757-0276	1	1
0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280	3	3
0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281	2	2
0757-0290	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290	1	1
0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346	1	1
0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394	1	1
0757-0405	R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405	2	2
0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407	1	1
0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	28480	0757-0410	2	1
0757-0411	R:FXD MET FLM 332 OHM 1% 1/8W	28480	0757-0411	1	1

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont.)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ 608E	TQ 608
0757-0413	R:FXD MET FLM 392 OHM 1% 1/8W	28480	0757-0413		1
0757-0419	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419	1	1
0757-0429	R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429	2	2
0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	28480	0757-0430	2	2
0757-0434	R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434	1	1
0757-0437	R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437	1	2
0757-0439	R:FXD MET FLM 6.81KOHM 1% 1/8W	28480	0757-0439	1	1
0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441	1	1
0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442	2	4
0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444	1	1
0757-0447	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447	1	1
0757-0457	R:FXD MET FLM 47.5K OHM 1% 1/8W	28480	0757-0457	2	2
0757-0464	R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464	1	1
0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465	2	2
0757-0801	R:FXD MET FLM 150 OHM 1% 1/2W	28480	0757-0802	1	1
0757-0811	R:FXD MET FLM 392 OHM 1% 1/2W	28480	0757-0811	1	1
0757-0833	R:FXD MET FLM 5.11K OHM 1% 1/2W	28480	0757-0833		1
0757-0838	R:FXD MET FLM 9.09K OHM 1% 1/2W	28480	0757-0838		1
0757-0841	R:FXD MET FLM 12.1K OHM 1% 1/2W	28480	0757-0841	1	1
0757-0852	R:FXD MET FLM 47.5K OHM 1% 1/2W	28480	0757-0852	1	1
0757-0854	R:FXD MET FLM 56.2K OHM 1% 1/2W	28480	0757-0854	2	2
0761-0021	R:FXD MET FLM 1K OHM 5% 1W	28480	0761-0021	1	1
0761-0058	R:FXD MET OX 750 OHM 5% 1W	28480	0761-0058	1	1
0812-0038	R:FXD WW 8.66K OHM 3% 5W	28480	0812-0038	1	1
0812-0050	R:FXD WW 3K OHM 5% 5W	28480	0812-0050	1	1
0813-0029	R:FXD WW 1 OHM 3% 3W	28480	0813-0029	1	1
0816-0002	R:FXD WW 3000 OHM 10% 10W	28480	0816-0002	1	1
0816-0006	R:FXD WW 5000 OHM 10% 10W	28480	0816-0006	1	1
0816-0032	R:FXD WW 4K OHM 5% 10W	28480	0816-0032	1	1
0818-0027	R:FXD WW 60 OHM 5% 40W	28480	0818-0027	1	1
0819-0003	R:FXD WW 5000 OHM 10% 20W	28480	0819-0003	1	1
0819-0022	R:FXD WW 50 OHM 5% 20W	28480	0819-0022	1	1
1120-0396	METER	28480	1120-0396	1	
1120-0397	METER	28480	1120-0397	1	1
1120-1505	METER:50UA	28480	1120-1505		1
1200-0005	SOCKET:TUBE,OCTAL	71785	101-24-11-314	2	2
1200-0008	SOCKET:ELECTRON TUBE 9-PIN MINIATURE	71785	121-25-11-055	4	4
1200-0009	SOCKET:TUBE 7-PIN MINAT	91662	04-703-05	6	6
1200-0010	SOCKET:TUBE FOR 2-PIN PENCIL TUBE	71785	131-52-12-016	2	2
1200-0019	SOCKET:TUBE 9-PIN MINIATURE	71785	121-39-22-011	1	1
1200-0028	SOCKET:CRYSTAL 2 PIN	91662	04-210-04	1	1
1205-0011	HEAT DISSIPATOR:FOR TO-5 AND TO-9 CASES	98978	TXBF-032-025B	4	4
1250-0001	CONNECTOR:RF BNC BULKHEAD MOUNT JACK	28480	1250-0001	1	3
1250-0053	CONNECTOR:RF BNC CAP AND CHAIN	28480	1250-0053	1	1
1250-0099	CONNECTOR:RF REAR PANEL MOUNT JACK	91737	7738-5	1	1
1250-0144	CONNECTOR:RECEPTACLE JACK CO-AXIAL TYPE	28480	1250-0144	1	1
1251-0071	JACK:TELEPHONE FOR 2-COND PLUG	82389	3J-1259	1	1
1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	79515	342014	1	1
1450-0009	LAMPHOLDER:MINIATURE BAYONET BASE	95263	708	2	2
1450-0013	SOCKET:CANDELABRA	72765	659-1	1	1
1450-0020	JEWEL:PILOT LIGHT,RED LENS	72765	#14L-113	1	1
1850-0087	TRANSISTOR:GERMANIUM 2N1544 PNP	04713	2N1544	1	1

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont.)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ 608E	TQ 608F
1853-0012	TRANSISTOR:PNP SILICON 2N2904A	04713	2N2904A	1	1
1854-0003	TRANSISTOR:NPN SILICON	28480	1854-0003	3	3
1854-0005	TRANSISTOR:SILICON NPN 2N708	02735	2N708	2	2
1854-0039	TRANSISTOR:SILICON 2N3053	02735	2N3053	1	1
1854-0071	TRANSISTOR:SILICON NPN	28480	1854-0071	3	3
1900-0017	DIODE:SYLVANIA	07397	1N21B	1	1
1901-0025	DIODE:SILICON 100WV 100MA	28480	1901-0025	5	5
1901-0026	DIODE:SILICON 0.75A 200 PIV	28480	1901-0026	6	6
1901-0028	DIODE:SILICON 0.75A 400PIV	28480	1901-0028	4	4
1901-0029	DIODE:SILICON 600 PIV	28480	1901-0029	4	4
1901-0518	DIODE:HOT CARRIER	28480	1901-0518	1	1
1902-0049	DIODE,BREAKDOWN: 6.19V 5%	28480	1902-0049	1	1
1902-0227	DIODE,BREAKDOWN:22.6V 5% 1.5W	28480	1902-0227	1	1
1902-3129	DIODE BREAKDOWN:7.50V 2%	28480	1902-3129	1	1
1910-0002	DIODE:GERMANIUM	82219	1N38B	1	1
1910-0011	DIODE:GERMANIUM 5MA AT 1V	28480	1910-0011	1	1
1921-0001	ELECTRON TUBE: UHF PENCIL TROIDE	86684	4042	1	1
1921-0002	ELECTRON TUBE: UHF PENCIL TRIODE	28480	1921-0002	1	1
1921-0036	ELECTRON TUBE:UHF TRIODE 9-PIN BASE	95984	EC 8010	1	1
1923-0017	ELECTRON TUBE:6AH6 PENTODE	33173	6AH6	2	2
1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	33173	6AU6	2	2
1930-0013	ELECTRON TUBE: 6AL5 TWIN DIODE	33173	6AL5	1	1
1932-0010	ELECTRON TUBE: 6080 DUAL TRIODE	86684	6080	2	2
1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	33173	12AT7	2	2
1932-0029	ELECTRON TUBE:DUAL TRIODE	28480	1932-0029	1	1
1932-0066	ELECTRON TUBE:DUAL TRIODE	33173	1932-0066	1	1
933-0013	ELECTRON TUBE:6U8A	02735	6U8A	1	1
940-0001	ELECTRON TUBE:5651	86684	5651A	1	1
2100-0036	R:VAR COMP 1000 OHM 20% 1/4W	28480	2100-0036	1	1
2100-0092	R:VAR COMP 10K OHM 20% LIN 1/5W	28480	2100-0092	1	1
2100-0151	R:VAR 500 OHM 20% 2/10W LIN	28480	2100-0151	1	1
2100-0156	R:VAR COMP 10K OHM 20% LIN 1/2W	28480	2100-0156	2	2
2100-0157	R:VAR COMP 50K OHM 20% LIN 1/3W	28480	2100-0157	2	2
2100-0159	R:VAR COMP 1 MEGOHM 20% 1/8W	28480	2100-0159	1	1
2100-0235	R:VAR COMP 5K OHM 20% LIN 2.25W	28480	2100-0235	1	1
2100-0281	R:VAR WW 100 OHM 20% LIN 1-1/2W	28480	2100-0281	1	1
2100-1619	R:VAR COMP DUAL 5K-50K OHM 20% 10C LOG	28480	2100-1619	2	2
2100-1750	R:VAR COMP 4K OHM 10% S-LIN 2.25W	28480	2100-1750		1
2110-0004	FUSE:CARTRIDGE 1/4 AMP 250V	75915	3AG/CAT. 312.250	1	1
2110-0006	FUSE:CARTRIDGE 2AMP 125V SLOW BLOW	71400	MDL2	1	1
2110-0014	FUSE:CARTRIDGE 4 AMP 125V SLOW BLOW	71400	MDX-4	1	1
2140-0007	LAMP:INCANDESCENT 250V 10W	24455	8A/S6 12V	1	1
2140-0009	LAMP:INCANDESCENT 6-8V TYPE 47	24455	47	2	2
3100-0899	SWITCH:ROTARY	28480	3100-0899	1	1
3101-0003	SWITCH:TOGGLE DPST(ON-NONE-OFF)	04009	81024-GT	1	1
3101-0012	SWITCH:TOG DPDT ON OFF ON	04009	82609	1	1
3101-0033	SWITCH:SLIDE DPDT(115-230V)	79727	G326-0001	1	1
3102-0006	SWITCH:SENSITIVE SPDT PIN PLUNGER	91929	22SM261	1	1
5040-0232	WINDOW:DIAL ATTENUATOR	28480	5040-0232	1	1
8120-0015	POWER CABLE	70903	KH3981/PH70/7.5FT	1	1
9100-0342	TRANSFORMER:POWER	28480	9100-0342	1	1
9100-2289	TRANSFORMER:POWER	28480	9100-2289	1	1
9120-0018	TRANSFORMER:AUDIO 15K : 600 OHM	28480	9120-0018	1	1
9140-0008	COIL:VAR 10.5-20 UH	98821	100D	1	1
9140-0026	COIL:FXD RF 6.8 UH	28480	9140-0026	1	1
9140-0035	COIL:VAR CT 10.5 UH	28480	9140-0035	1	1
9140-0036	COIL:VAR CT 450-500 UH	28480	9140-0036	1	1

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont.)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ 608E	TQ 608F
		28480	9140-0096	1	1
9140-0096	COIL:FXD RF 1 UH	02114	56-590-65A2/4A	1	1
9170-0029	BEAD:FERRITE	28480	00608-600	1	
00608-600	GENERATOR ASSY	28480	00608-60037	2	2
00608-60037	CABLE:UNCAL OUTPUT ASSY	28480	00608-601	1	
00608-601	ALC BOARD ASSY	28480	00608-602	1	
00608-602	BUFFER ASSY				
00608-603	TURRET OSCILLATOR ASSY	28480	00608-603	1	
00608-604	ASSY:RESISTOR RECTIFIER BOARD	28480	00608-604	1	1
00608-606	CABLE:POWER HARNESS	28480	00608-606	1	1
00608-607	CABLE:PANEL HARNESS	28480	00608-607	1	1
00608-610	ATTENUATOR PLUNGER ASSY	28480	00608-610	2	2
00608-611	CABLE:LEVELLER IN	28480	00608-611	1	1
00608-612	CABLE:LEVELLER OUT	28480	00608-612	1	1
00608-613	BOARD:RESISTOR ASSY	28480	00608-613	1	1
00608-614	BOARD:RESISTOR ASSY	28480	00608-614	1	1
00608-620	GENERATOR ASSY	28480	00608-620		1
00608-621	BOARD:ALC ASSY	28480	00608-621		1
00608-622	BUFFER ASSY	28480	00608-622		1
00608-623	OSCILLATOR TURRET ASSY	28480	00608-623		1
00608-624	FILTER:VARICAP	28480	00608-624		1
00608-625	BOARD:VARICAP ASSY	28480	00608-625		1
00608-626	AMPLIFIER TURRET ASSY	28480	00608-626		1
608A-27A	FILTER:A RED	28480	608A-27A	2	2
608A-27D	FILTER:D GREEN	28480	608A-27D	4	4
608C-40A	ATTENUATOR DIAL ASSY	28480	608C-40A	1	1
608C-60A	TURRET ASSY:AMP	28480	608C-60A	1	
608D-16J	CABLE:CRYSTAL CALIBRATOR	28480	608D-16J	1	1
608D-16R	CABLE:CRYSTAL CALIBRATOR ADJUST	28480	608D-16R	1	1
608D-27B	FILTER:RF(WHITE)	28480	608D-27B	1	1
608D-27C	FILTER:RF(MOD,BLUE)	28480	608D-27C	1	1
608D-40C	DIAL:FREQUENCY VERNIER	28480	608D-40C	1	1
608D-44R	CABINET ASSY:RACK	28480	608D-44R	1	1
608D-44S	CABINET ASSY	28480	608D-44S	1	1
608D-58A	CONTACT:AMP GRID	28480	608D-58A	1	1
608D-59A-3	SOCKET:OSCILLATOR TUBE	28480	608D-59A-3	1	1
608D-59A-4	SOCKET:OSCILLATOR GRID	28480	608D-59A-4	1	1
608D-59H	SPECIAL TRIMMER:FINE FREQ ADJUST	28480	608D-59H	1	1
608D-60K	CHOKE:RF	28480	608D-60K	1	1
608D-60M	CHOKE:RF	28480	608D-60M	1	1
608D-75A	BOARD:RESISTOR ASSY	28480	608D-75A	1	1
608D-75B	BOARD:RESISTOR ASSY	28480	608D-75B	1	1
608D-75T	BOARD:RECTIFIER ASSY	28480	608D-75T	1	1
608D-82	C:FXD MICA 60 PF 10% 600VDCW	28480	608D-82	1	1
608D-83C	WINDOW:FREQ DIAL	28480	608D-83C	1	1
612A-38A	WRENCH:TUBE	28480	612A-38A	3	3

 # See introduction to this section for ordering information

TABLE 6-3.
CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00809	Croven Ltd.	Whitby, Ontario Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Calif.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
02875	Hudson Tool & Die Co.	Newark, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Calif.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04673	Dakota Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp.	Chicago, Ill.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13103	Thermolloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15106	The Sphere Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Farmington, Mich.
16352	Computer Diode Corp.	Lodi, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokoma, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17554	Components Inc.	Biddeford, Ma.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17856	Siliconix Inc.	Sunnyvale, Calif.

TABLE 6-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Parelco Inc.	San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialities Mfg. Co., Inc.	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78424	Speciality Leather Prod. Co.	Newark, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio

TABLE 6-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N,J,
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83014	Hartwell Corp.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Calif.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Malco Mfg. Co., inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94142	Phelps Dodge	Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Dania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
96508	Xcelite Inc.	Orchard Park, N.Y.
96733	San Fernando Elect. Mfg. Co.	San Fernando, Calif.
96881	Thomson Ind. Inc.	Long Is., N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

SECTION VII
SCHEMATIC DIAGRAMS
COMPONENT LOCATION INFORMATION

7-1. INTRODUCTION.

7-2. Schematic presentations in this manual show electrical circuit operation and are not intended to serve as wiring diagrams. Figure 7-1 shows an example of the schematic illustrations. Figure 7-2 lists notes which apply to the schematic diagrams.

7-3. Circuit board assemblies are shown in part on different pages. To find a specific instrument component, refer to the "REFERENCE DESIGNATIONS" box which appears on each schematic diagram.

7-4. Component procurement information and specific component descriptions are included in Section VI. Refer to page 6-1 for information on how to order parts.

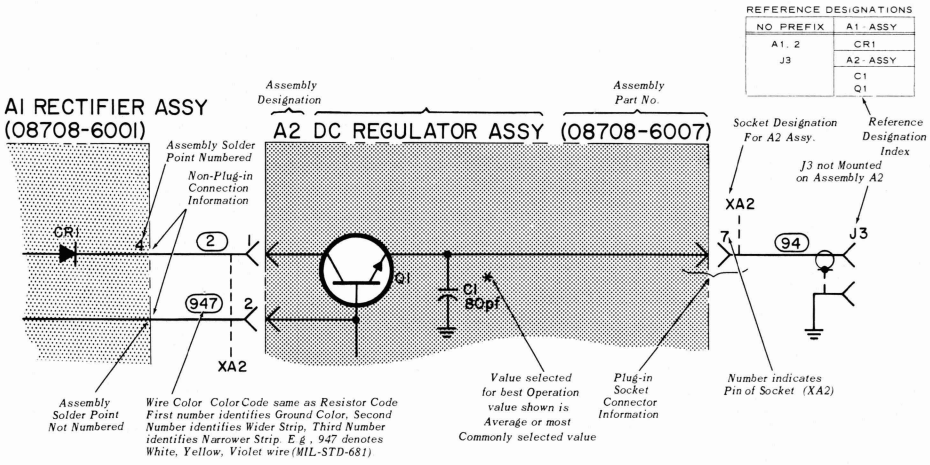
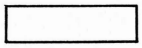


Figure 7-1. Schematic Information Illustration

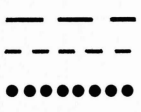
1. Resistance is in ohms, capacitance is in microfarads unless otherwise noted.

2. Screwdriver adjustment.

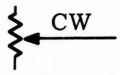
Panel control.

3.  Encloses front panel designations.

4. Signal path.

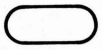
 Denotes feedback paths, used in different circuits.

5. Circuit assembly borderline.

6. 

Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

7. Test point. Number in circle matches TP number.

10.  Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider strip, and the third number identifies the narrow strip. E G., (947) denotes white base, yellow wide stripe, violet narrow stripe

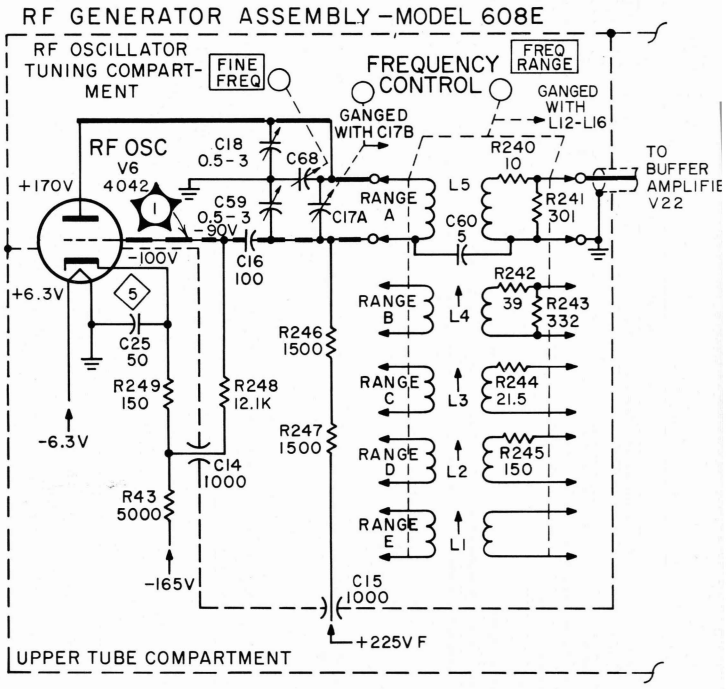
11. Voltage regulator (breakdown) diode.

12. Feed-through capacitor (shunt capacitor, commonly used for bypassing high frequency currents to chassis).

Figure 7-2. Schematic Diagram Notes

NOTES:

1. INSTALLED IN MODEL 608F ONLY.
2. VALUE SELECTED IN TEST-NOMINAL VALUE SHOWN.
3. R214 IS 200 OHMS IN MODEL 608E AND 392 OHMS IN MODEL 608F.
4. R251 IS 301 OHMS IN MODEL 608E AND 200 OHMS IN MODEL 608F.
5. C25 IS NSR: PART OF V6.
6. R114 IS NSR: PART OF FL9.
7. C37 AND C69 ARE NSR: PART OF ATI.
8. L17 IS NSR: PART OF BOLOMETER.
9. INDICATED VOLTAGES-IMC PULSE SET RF OUTPUT MODE.



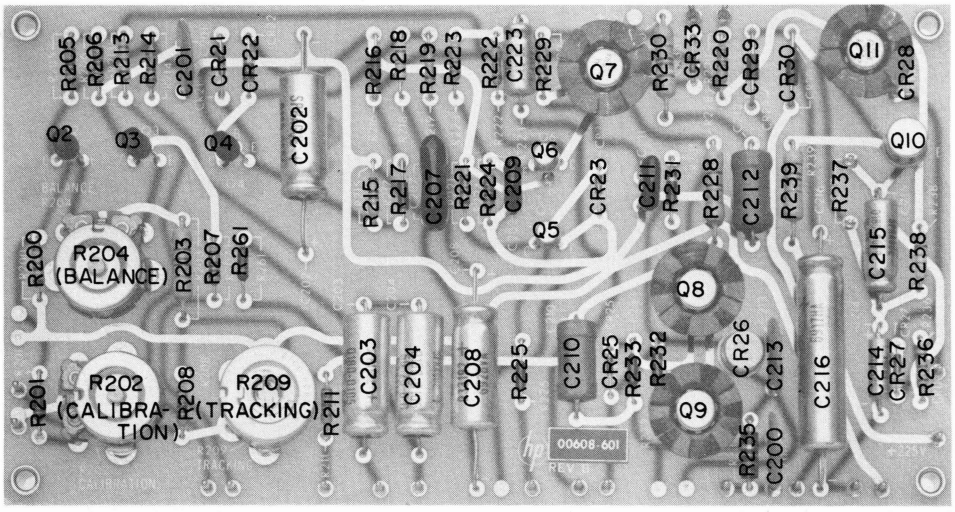
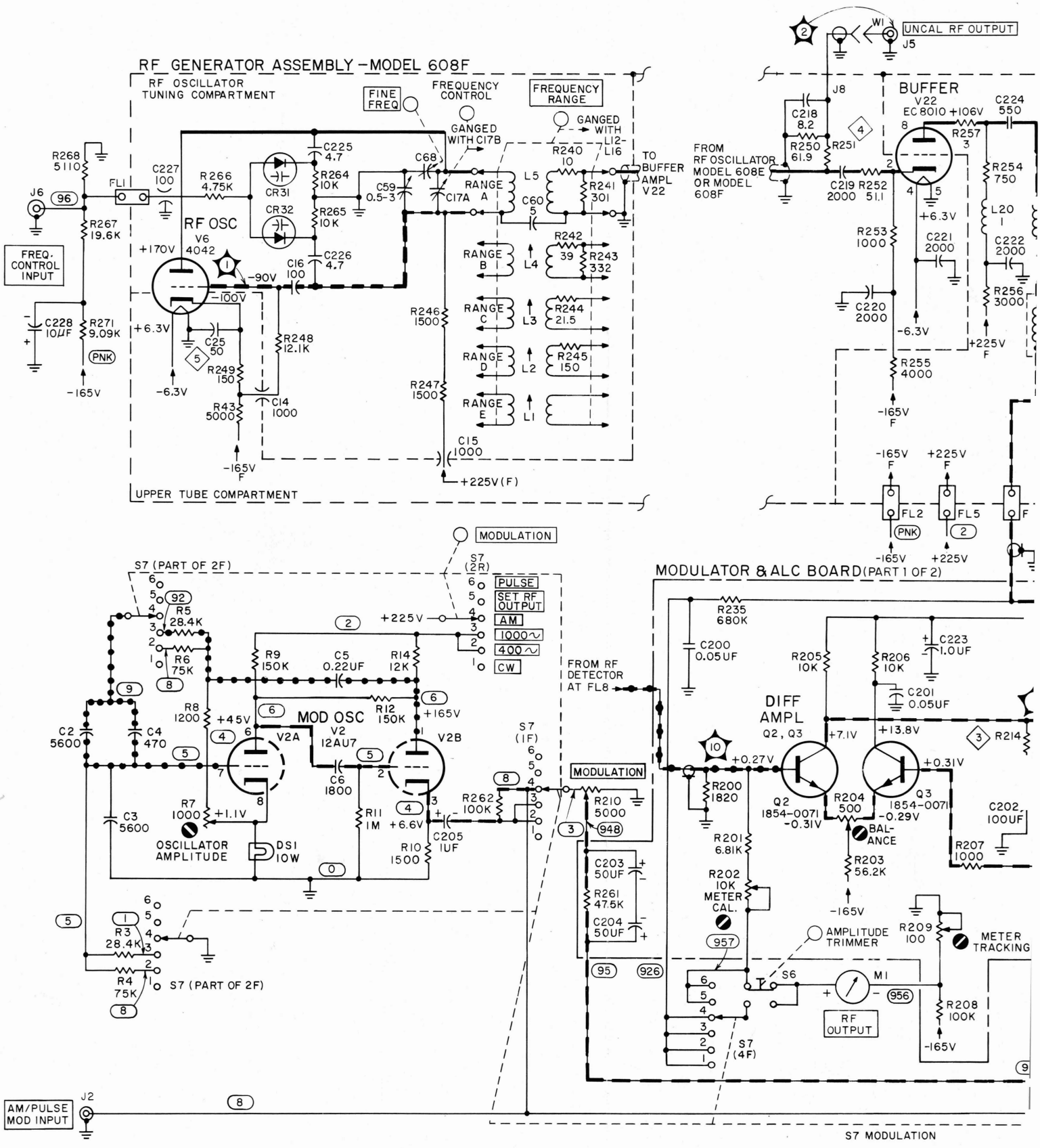


Figure 7-3. Component Identification, Modulation and ALC Board


RF GENERATOR ASSEMBLY - MODEL 608F
RF OSCILLATOR TUNING COMPARTMENT
FINE FREQ
FREQUENCY CONTROL
FREQUENCY RANGE
GANGED WITH C17B
GANGED WITH L12-L16
RF OSC
V6
4042
+170V
-90V
-100V
+6.3V
-6.3V
-165V
-165V F
+225V(F)
FREQ. CONTROL INPUT
J6
96
R268 5110
R267 19.6K
C228 10µF
R271 9.09K
PNK
FL1
C227 100
R266 4.75K
CR31
CR32
C225 4.7
R264 10K
R265 10K
C226 4.7
C16 100
C25 50
R248 12.1K
R249 150
R43 5000
C14 1000
C59 0.5-3
C68
C17A
C17B
RANGE A
RANGE B
RANGE C
RANGE D
RANGE E
L5
L4
L3
L2
L1
C60 5
R240 10
R241 301
R242 39
R243 332
R244 21.5
R245 150
R246 1500
R247 1500
C15 1000
TO BUFFER AMPL V22
UPPER TUBE COMPARTMENT
UNCAL RF OUTPUT
J5
W1
J8
FROM RF OSCILLATOR MODEL 608E OR MODEL 608F
BUFFER
V22
EC 8010
+106V
C218 8.2
R250 61.9
R251
C219 2000
R252 51.1
R257 3
C224 550
R254 750
L20 1
C222 2000
R256 3000
C221 2000
R253 1000
C220 2000
R255 4000
+6.3V
-6.3V
+225V F
-165V F
FL2
FL5
PNK
MODULATION
S7 (PART OF 2F)
S7 (2R)
PULSE
SET RF OUTPUT
AM
1000~
400~
CW
R5 28.4K
R6 75K
R9 150K
C5 0.22UF
R14 12K
+225V
R8 1200
+45V
MOD OSC
V2
12AU7
V2A
V2B
R12 150K
+165V
C2 5600
C4 470
C6 1800
R7 1000
+1.1V
OSCILLATOR AMPLITUDE
DS1 10W
R11 1M
+6.6V
C205 1UF
R10 1500
C3 5600
R262 100K
S7 (1F)
R3 28.4K
R4 75K
S7 (PART OF 2F)
MODULATOR & ALC BOARD (PART 1 OF 2)
FROM RF DETECTOR AT FL8
R235 680K
C200 0.05UF
R205 10K
R206 10K
C223 1.0UF
C201 0.05UF
DIFF AMPL
Q2, Q3
+7.1V
+13.8V
R214
+0.27V
+0.31V
R200 1820
Q2 1854-0071
-0.31V
R204 500
BAL-ANCE
-0.29V
Q3 1854-0071
C202 100UF
R207 1000
R201 6.81K
R202 10K METER CAL.
R203 56.2K
R210 5000
C203 50UF
R261 47.5K
C204 50UF
AMPLITUDE TRIMMER
R209 100
METER TRACKING
S6
M1
RF OUTPUT
R208 100K
S7 (4F)
AM/PULSE MOD INPUT
J2
S7 MODULATION

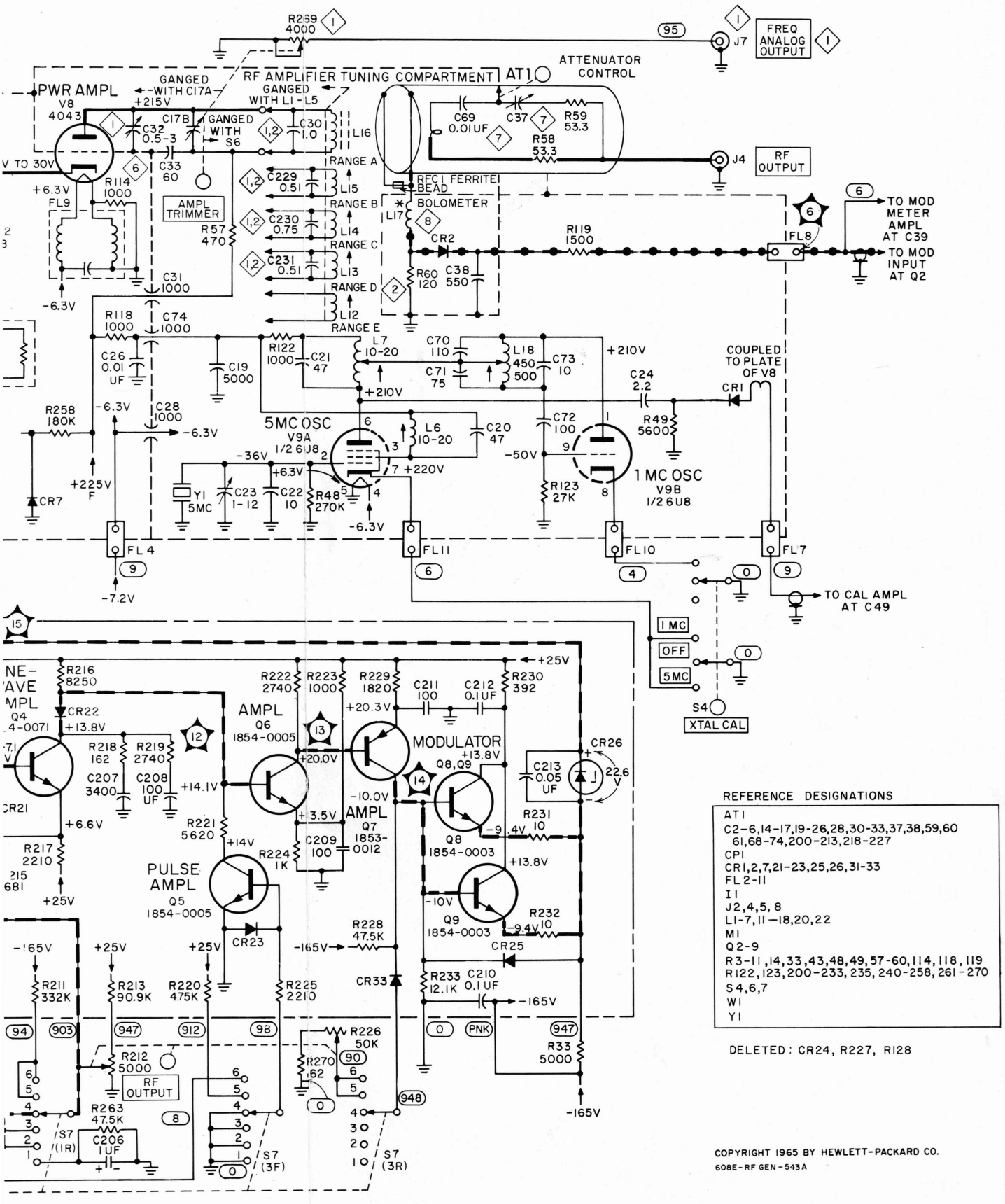


Figure 7-4. RF Generator and Modulator Schematic Diagram

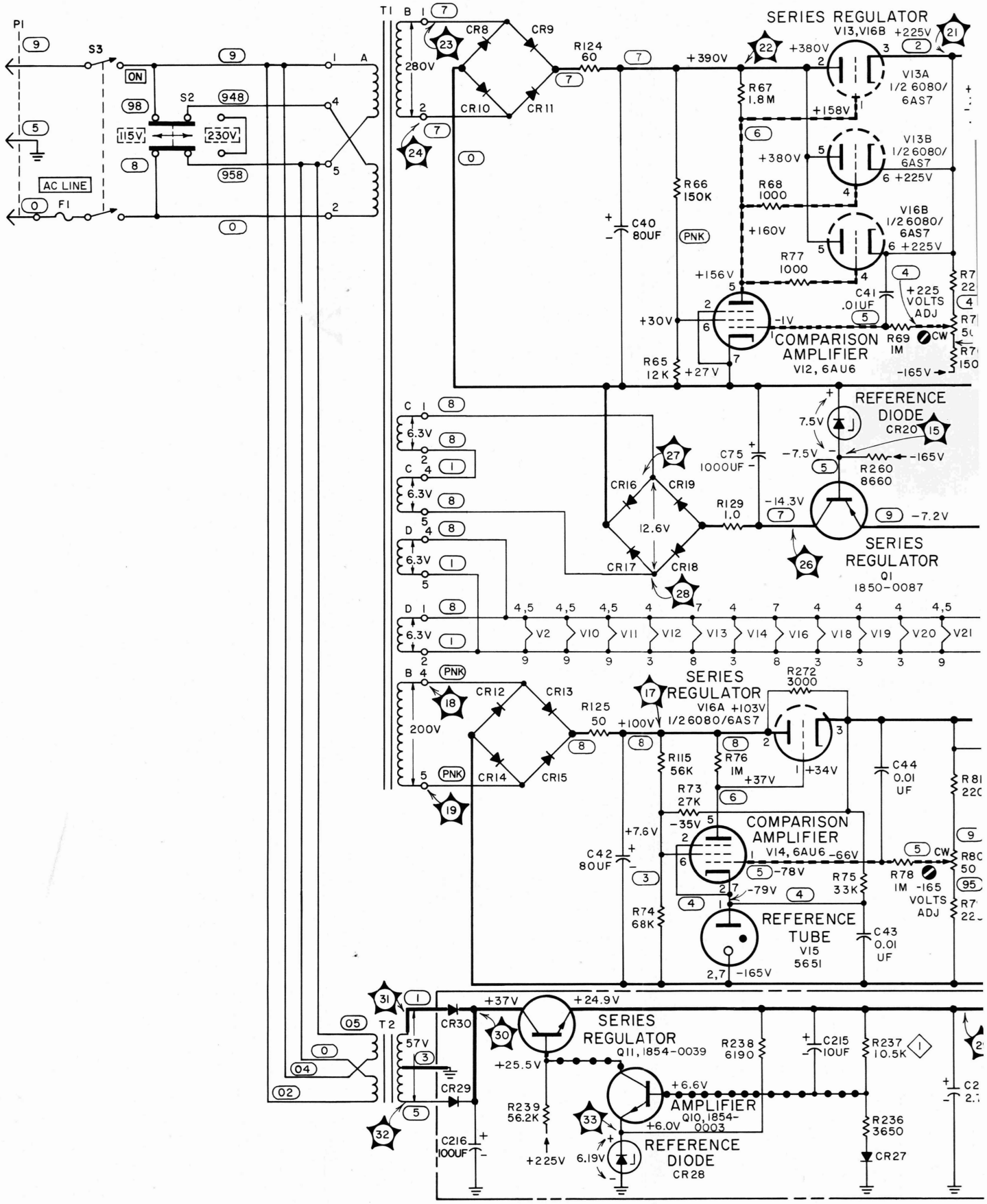
REFERENCE DESIGNATIONS

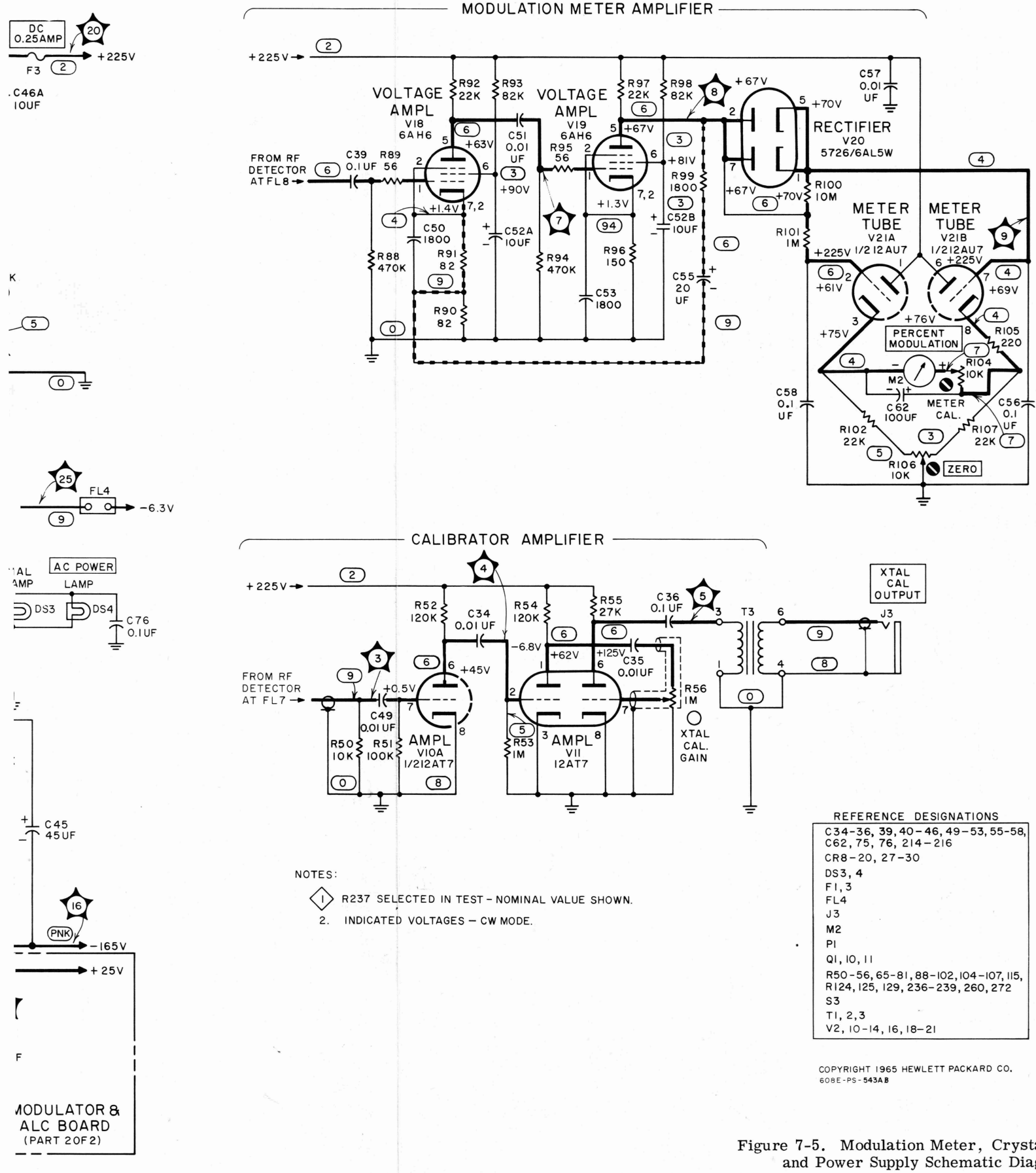
AT1
C2-6,14-17,19-26,28,30-33,37,38,59,60
61,68-74,200-213,218-227
CP1
CR1,2,7,21-23,25,26,31-33
FL2-11
I1
J2,4,5,8
L1-7,11-18,20,22
M1
Q2-9
R3-11,14,33,43,48,49,57-60,114,118,11
R122,123,200-233,235,240-258,261-2
S4,6,7
W1
Y1

DELETED: CR24, R227, R128

Figure 7

RF Generator and Modulator Schema
Diagr


P1
S3
ON
S2
948
115V
230V
958
AC LINE
F1
T1
CR8
CR9
CR10
CR11
280V
R124
60
+390V
SERIES REGULATOR
V13, V16B
+225V
+380V
V13A
1/2 6080/
6AS7
+158V
V13B
1/2 6080/
6AS7
+380V
6 +225V
R67
1.8M
R66
150K
R68
1000
V16B
1/2 6080/
6AS7
+160V
6 +225V
R77
1000
+156V
C40
80UF
PNK
C41
.01UF
+225
VOLTS
ADJ
+30V
-1V
R69
1M
CW
COMPARISON
AMPLIFIER
V12, 6AU6
R65
12K
+27V
-165V
REFERENCE
DIODE
CR20
7.5V
-7.5V
-165V
C75
1000UF
R260
8660
CR16
CR19
CR17
CR18
12.6V
R129
1.0
-14.3V
-7.2V
SERIES
REGULATOR
Q1
1850-0087
6.3V
4,5
V2
V10
V11
V12
V13
V14
V16
V18
V19
V20
V21
CR12
CR13
CR14
CR15
200V
R125
50
+100V
SERIES
REGULATOR
V16A +103V
1/2 6080/6AS7
R272
3000
+34V
R115
56K
R76
1M
+37V
C44
0.01
UF
R73
27K
-35V
COMPARISON
AMPLIFIER
V14, 6AU6
-66V
+7.6V
C42
80UF
-78V
R75
33K
R78
1M -165
VOLTS
ADJ
-79V
R74
68K
REFERENCE
TUBE
V15
5651
C43
0.01
UF
2,7 -165V
T2
57V
CR30
CR29
+37V
+24.9V
SERIES
REGULATOR
Q11, 1854-0039
+25.5V
R238
6190
C215
100UF
R237
10.5K
+6.6V
AMPLIFIER
Q10, 1854-
0003
+6.0V
R239
56.2K
+225V
6.19V
REFERENCE
DIODE
CR28
C216
100UF
R236
3650
CR27



NOTES:

1. R237 SELECTED IN TEST – NOMINAL VALUE SHOWN.
2. INDICATED VOLTAGES – CW MODE.

REFERENCE DESIGNATIONS

C34-36, 39, 40-46, 49-53, 55-58, C62, 75, 76, 214-216
CR8-20, 27-30
DS3, 4
F1, 3
FL4
J3
M2
P1
Q1, 10, 11
R50-56, 65-81, 88-102, 104-107, 115, R124, 125, 129, 236-239, 260, 272
S3
T1, 2, 3
V2, 10-14, 16, 18-21

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608E-PS-543AB

Figure 7-5. Modulation Meter, Crystal and Power Supply Schematic Diagr

REFERENCE DESIGNATIONS
C34-36, 39, 40-46, 49-53, 55-58, C62, 75, 76, 214-216
CR8-20, 27-30
DS3, 4
F1, 3
FL4
J3
M2
P1
Q1, 10, 11
R50-56, 65-81, 88-102, 104-107, 115, R124, 125, 129, 236-239, 260, 272
S3
T1, 2, 3
V2, 10-14, 16, 18-21

Figure 7-5

Modulation Meter, Crystal Calibration, and Power Supply Schematic Diagrams

APPENDIX I

BACKDATING

MANUAL CHANGES

Model 608E

VHF SIGNAL GENERATOR

Make all backdating corrections in this manual according to the changes below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
539- below 00120	A through M
543-	B through M
610-, 637-	C through M
637- above 00320	D through M
710-	E through M
742-	F through M
742- above 00970	G through M
826-	H through M

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
833-	I through M
833- above 01671	J, through M
833- above 01821	K, L, M
833- above 02121	L, M
833- above 02720	M

CHANGE A

Figure 7-5 and Parts List:
Add (in series with emitter of Q1): R128, HP Stock No.0812-0033, Fixed WW 7 ohm 3% 5W.
CR20, change HP Stock No. to 1902-0037.

CHANGE B

Table 6-1:
Change Q7 to HP Stock No. 1850-0103, 2N2190 under Q7 change HP Stock No. 1205-0011 to read 1205-0012. (Change included in instruments 710-00500 and below. Recommended change for all older models).

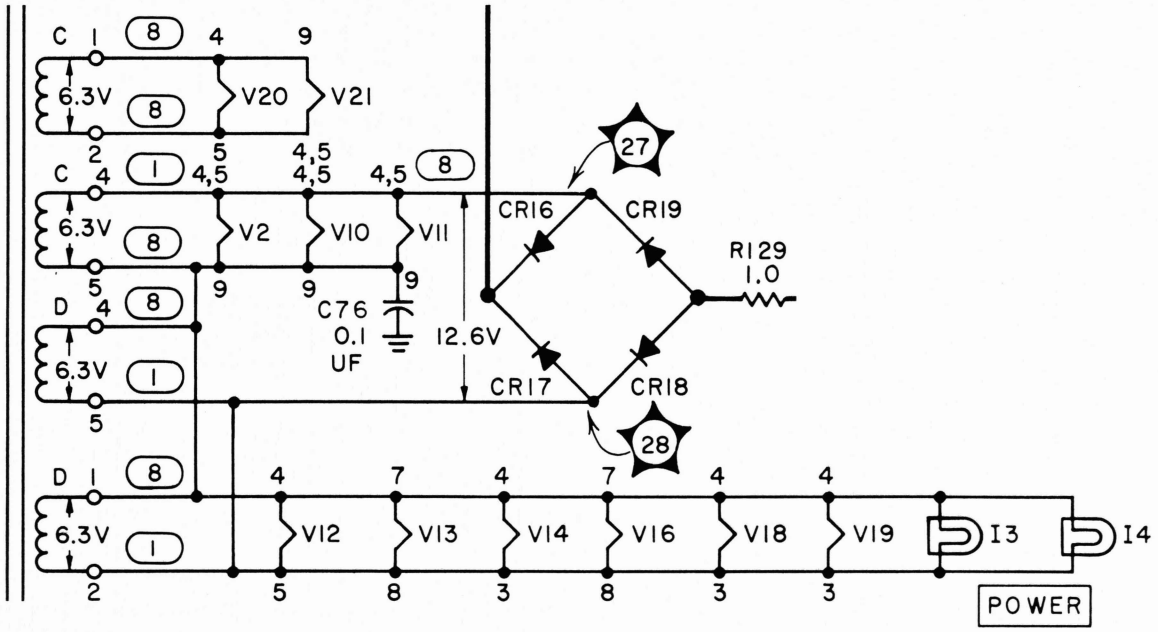
Delete under R237 descriptions: "Factory selected part - typical value given."

Table 6-2:
Change HP Stock No. 1205-0011 to 1205-0012.
Change HP Stock No. 1853-0012, 2N2904A to 1850-0103, 2N2190.

Figure 7-5:
Delete asterisk (*) after R237 denoting factory selection; typical value given.

CHANGE C

Figure 7-5 and Parts List:
Change T1 HP Stock No. from 9100-2289 to 9100-0047.
Change schematic to show filament wiring of T1 as follows:



CHANGE D

Parts List:
Add the following:
Right-angle connector, HP Stock No. 1250-0076.
BNC connector J8, HP Stock No. 1250-0118.

Change the HP Stock No. of cable assembly W1 from 00608-60037 to 00608-605.

CHANGE E

Table 1-1:
Change second sentence of External Pulse Modulation specification to read, "From 220 MHz to 480 MHz, combined rise and decay time less than 2 μsec.

Paragraph 5-27, step h:
Change test limit for "Combined pulse rise and decay times" to read, ... "2 μsec max."

CHANGE F

Figure 7-5 and Parts List:
Change Resistor R237 typical value from 10.5K, HP Stock No. 0698-4477 to 11K, HP Stock No. 0757-0443. Delete the asterisk indicating typical value given.

CHANGE G

Figure 7-4 and Parts List:
Change MOD OSCILLATOR resistor R12 from 150K to 100K, 1W, 10%, HP Stock No. 0690-1041.

Change schematic to show R12 connected between plate of V2A (pin 6) and cathode of V2A (pin 8).

Change Tube V2 HP Stock No. to 1932-0043.

Parts List:
Change F1 to:
2110-0013, 3.2 amp, slow-blow, for 115V operation
2110-0005, 1.6 amp, slow-blow, for 230V operation

CHANGE H

Table 1-1:
Change drift specification to read:
"Less than 50 parts in 10^6 per 10 minute period after one hour warmup. Less than 10 minutes to restabilize after changing frequency."

Parts List:
Change V2 from HP Part No. 1932-0029 to HP Part No. 1932-0066.

CHANGE I

Figure 7-4 and Parts List:
Change Resistor R7 from 1K, HP Part No. 2100-0036 to 2K, HP Part No. 2100-0010.

Change Resistor R8 from 1.2K, HP Part No. 0690-1221 to 680 ohms, HP Part No. 0690-6811.

CHANGE J

Figure 7-4 and Parts List:
Delete Ferrite Bead RFC1, HP Part No. 9170-0029.

CHANGE K

Parts List:
Change Diode CR1 from HP Part No. 1901-0518 to HP Part No. 1901-0011.

CHANGE L

Figure 7-5 and Parts List:
Change Capacitor C216 from 50 WVDC, HP Part No. 0180-1819 to 100 MF 40V, HP Part No. 0180-0138.

CHANGE M

Figure 7-3:
Change ALC Board pictorial to show soldered connections around the edges, instead of plug-in pins.

APPENDIX II

BACKDATING

MANUAL CHANGES

Model 608F

VHF SIGNAL GENERATOR

Make all backdating corrections in this manual according to the changes below.

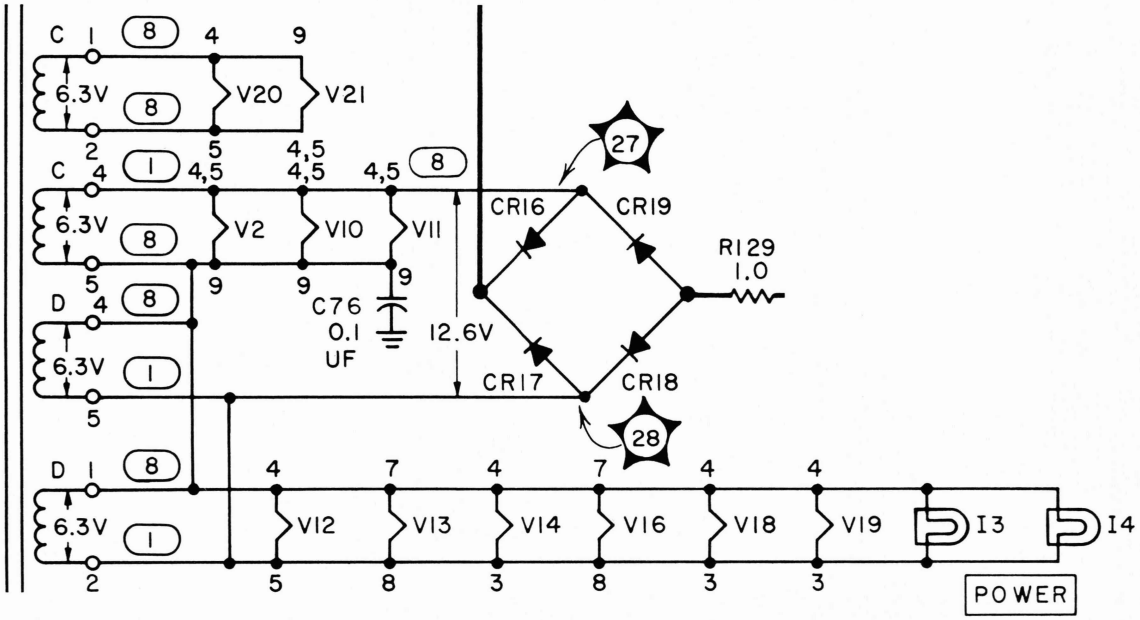
SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
530-	A through N
608-	B through N
610-, 637-	C through N
637- above 00200	D through N
710-	E through N
742-	F through N
742- above 00850	G through N
824-	H through N

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
827-	I through N
832-	J through N
832- above 01101	K, through N
832- above 01151	L, M, N
832- above 01251	M, N
832- above 01501	N

CHANGE A — Figure 7-5 and Parts List:
Delete Resistor R129, 1 ohm, HP Stock No. 0813-0029.

CHANGE B — Figure 7-5 and Parts List:
Change T1 from HP Stock No. 9100-2289 to 9100-0047.

Change schematic to show filament wiring of T1 as follows:



CHANGE C

Parts List:
Add the following:
Right-angle connector, HP Stock No. 1250-0076; BNC connector J8, HP Stock No. 1250-0118.

Change the HP Stock No. of cable assembly W1 from 00608-60037 to 00608-605.

CHANGE D

Table 6-1:
Change Q7 to HP Stock No. 1850-0103, 2N2190. Under Q7 change HP Stock No. 1205-0011 to read 1205-0012. (Change included in instruments 710-00500 and below. Recommended change for all older models.)

Delete under R237 description: "Factory selected part - typical value given."

Table 6-2:
Change HP Stock No. 1205-0011 to 1205-0012.
Change HP Stock No. 1853-0012, 2N2904A to 1850-0103, 2N2190.

Figure 7-5:
Delete asterisk (*) after R237 to denoting factory selection; typical value given.

Table 1-1 (instrument serials below 710-00550):
Change Auxiliary RF Output specification to read:

"Fixed level CW signal from RF Oscillator (min amplitude 180 mv rms into 50 ohms) provided at front panel BNC female connector for use with HP 8708A Synchronizer or other external equipment (e.g. frequency counter)."

Paragraph 5-22, step b (instrument serials below 710-00550):
Change to read, "Power meter should indicate -1.8 dBm minimum."

CHANGE E

Table 1-1:
Change second sentence of External Pulse Modulation specification to read:

"Above 220 MHz, combined rise and decay time less than 2 μsec."

Paragraph 5-27 step h:
Change test limit for "Combined pulse rise and decay times" to read:

"2 μsec max."

CHANGE F

Figure 7-5 and Parts List:
Change Resistor R237 typical value 10.5K, HP Stock No. 0698-4477 to 11K, HP Stock No. 0757-0443. Retain the asterisk to indicate typical value given.

CHANGE G

Parts List:
Change Meter, M1, HP Stock No. from 1120-1505 to 1120-0396.

CHANGE H

Figure 7-4 and Parts List:
Change Resistor R12 from 150K, HP Stock No. 0690-1541 to 100K, HP Stock No. 0690-1041.
Change Tube V2 HP Stock No. 1932-0043.
Change schematic to show R12 connected from V2A pin 6 to V2A pin 8.

CHANGE I

Table 1-1:
Change drift specification to read:

"Less than 50 parts in 10^6 per 10 min period after one hour warmup. Less than 10 min to restabilize after changing frequency.
Stability when used with 8708A Synchronizer:
5×10^{-8}/min; 2×10^{-7}/10 min; 2×10^{-6}/day; $2 \times 10^{-7}/^{o}C$ (0^{o} to $55^{o}C$);
2×10^{-7}/10% line voltage change."

Parts List:
Change F1 to:
2100-0014, 3.2 amp, slow blow, for 115V operation.
2100-0005, 1.6 amp, slow blow, for 250V operation.
Change V2 from HP Part No. 1932-0029 to HP Part No. 1932-0066.

CHANGE J

Figure 7-4 and Parts List:
Change Resistor R7 from 1K, HP Stock No. 2100-0036 to 2K, HP Stock No. 2100-0010.

Change Resistor R8 from 1.2K, HP Stock No. 0690-1221 to 680 ohms, HP Stock No. 0690-6811.

CHANGE K

Figure 7-4 and Parts List:
Delete Ferrite Bead RFC1, HP Stock No. 9170-0029.

CHANGE L

Parts List:
Change Diode CR1 from HP Stock No. 1901-0518 to HP Stock No. 1910-0011.

CHANGE M

Figure 7-5 and Parts List:
Change Capacitor C216 from 50 WVDC, HP Stock No. 0180-1819 to 100 MF 40V, HP Stock No. 0180-0138.

CHANGE N

Figure 7-3:
Change ALC Board pictorial to show soldered connections around the edges, instead of plug-in pins.

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